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Proceedings of the Thirty-fifth Annual Meeting of the American Association of Economic Entomologists (*Continued*)

Morning session, Saturday, December 30, 1922

The session was called to order at 9 o'clock and two papers were presented on dusting with an aeroplane. At the conclusion, a joint session was held with the American Phytopathological Society.

PRESIDENT J. G. SANDERS: The first paper will be given by Mr. J. S. Houser.

DUSTING TALL TREES BY AIRPLANE FOR LEAF EATING INSECTS

By J. S. HOUSER, *Wooster, Ohio*

ABSTRACT

A thirty acre mixed woodland infested with canker worm, *Antisopteryx*, and a four acre catalpa grove infested with catalpa sphinx, *Ceratomia catalpae*, were dusted from an airplane with undiluted arsenate of lead. A satisfactory kill was obtained in both instances and further data as to best ways of manipulating the machine, etc., obtained. Trained observers who witnessed the trials were fully convinced the method is one of true merit and will prove distinctly useful in the future because of its extreme rapidity and because it may be utilized under conditions which prohibit the use of land going machines.

At the last annual meeting of the Association of Economic Entomologists, the writer reported the successful use of the airplane as an instrument for distributing poison dust on tall trees.

The present paper reports two additional tests made during the past summer, the first of which involved the treatment of a thirty acre mixed woodland at Cleveland, Ohio, for the control of canker worm

and the second pertained to the dusting of a four acre catalpa grove near Casstown, Ohio, moderately infested with the catalpa sphinx.

As in the work of 1921, that of the present season was done in co-operation with the United States Aviation Experimental Station at McCook Field, Dayton, Ohio, and it is a pleasure to again recognize the efficient, painstaking effort of all of the men of the Field who were in any way connected with the project. We were fortunate to again have the services of Lieut. J. A. Macready as pilot for the Cleveland test and of Mr. M. Dormoy to operate the hopper in both of the tests. In the absence of Lieut. Macready, Lieut. Moseley piloted the dusting plane for the Casstown test.

The same hopper for carrying and distributing the poison was used this year as last and the plane was of the same type, a Curtiss JN-6. In both tests this season a second plane accompanied the dusting plane for observation and photographic purposes.

The powder used was an undiluted, finely ground, flocculent type of arsenate of lead, which, according to our present standards, sticks fairly well in the dry form to foliage. However, there still remains considerable room for improvement of the adherent properties of the material and it would seem that researches having for their object the improvement of this property of the poison are much to be desired. Some trouble was experienced with the powder compacting in the hopper, particularly if the plane flew several miles through "bumpy" air after the hopper was filled. This, however, is a mechanical defect which could be overcome quite easily through the installation of a simple agitator.

The Cleveland Test

The woodland in which this work was done was a part of the J. L. Severance estate and is located some twelve to fifteen miles east of the center of Cleveland. It is almost square in shape with but slight topographical variations and covered approximately thirty acres. The trees were irregular both in size and spacing, varying in height from 20 to 65 feet. In some parts of the woods the stand was very thin while in others the taller trees were close together and beneath them was a dense growth of underbrush and low-growing shrubbery.

The native tree fauna of northern Ohio was fairly well represented in the plot, the predominating species being beech. Others represented were hard and soft maple, American elm, basswood, oaks of various species, ironwood, etc. The native undergrowth had been supplemented

with plantings of ferns, wild flowers, rhododendrons and other shrubs, a studied effort having been made to preserve the natural effect, rather than create an artificial atmosphere. The result is most pleasing and at the same time it had been made almost impossible to use liquid machines without doing serious damage by trampling the low growing plants.

The infestation of canker worm larvae was only moderately severe. In no part of the woodland in which we operated were the insects sufficiently plentiful to cause defoliation, though it is no uncommon thing in northern Ohio for woodlands to be stripped by this insect. There were, however, enough caterpillars to cause considerable mutilation of the leaves of the more susceptible species, such as, elms, linden and maple and thus furnish a fair basis for the experiment.

Object of the Test

The more important points under consideration in this test were as follows:—

1. To determine if cankerworms can be controlled successfully by dusting.
2. To determine whether the dust released above a dense woodland will penetrate through the foliage of the tree crowns to the undergrowth beneath, as well as to determine the degree to which the dust may be controlled when so applied.
3. To secure such data as possible pertaining to the general practicability and defects of this method of forest insect control.

Details of Applying the Dust

The Postal Landing Station and Hangars at the Glen Martin Field, some four miles distant from the Severance tract, were used as a base of operations.

On the afternoon of May 23, Lieut. Macready made a careful ground inspection of the woodland to be treated, and in passing it may be said that while a ground inspection previous to the act of application may not be essential, it undoubtedly is of considerable value to the pilot later on.

During the forenoon of the following day, May 24, approximately 325 lbs. of powder was distributed over the woodland. The meterological conditions were not very favorable, the chief unsatisfactory factor being a wind which not only changed direction occasionally but in velocity as well, the latter averaging about 12 to 15 miles per hour. This is too high when operating over an area as small as 30 acres.

For the most part the plane flew crosswise of the wind in order to

secure a satisfactory distribution of the powder and just as low as possible, perhaps averaging not more than 20 feet above the crowns of the taller trees. Although plans were made to secure the precise time taken in the liberation of the dust by stationing observers in different parts of the woodland, it was found impossible to do this accurately since the observers could not always see just when the hopper was opened and closed.

No dust was applied during the afternoon of May 24. In the early evening of that day, 7¼ hours after the last hopperful of poison had been distributed and before the lead had had a chance to "set" by dew, a violent rainstorm almost of the dimensions of a cloudburst occurred. The following morning intermittent showers fell until about 11 o'clock when the weather cleared and an additional 100 lbs. of the powder was applied to a section of the woods.

Behavior of the Dust When Released

The influence of the "slip stream" persisted some seconds after the dust was released and the white trail floated out behind the moving plane. Presently, however, this was lost and the wind floated the dust cloud over and through the trees. One of the most gratifying phases of the behavior of the dust was its power of penetration or what may be termed its "covering power." After the dust cloud was liberated over the woodland it gradually settled through the crowns of the trees or the upper canopy of foliage, and for a period of four minutes after the passage of the plane we were able to detect floating particles of it.

As a result of this comparatively long period, most excellent distribution was effected. Not only were the tree tops well covered, but the leaves of the underbrush as well. Even the leaves of plants growing under the double canopy of tree tops and underbrush were well covered, and it is the writer's belief that the distribution of the poison excelled that which might have been obtained by the use of liquid sprays.

Effect of the Poison on the Caterpillars

Following the dusting of May 24, when it will be recalled the work was discontinued at noon and a heavy rain fell 7¼ hours later, a large sheet 9 x 9 ft. was placed near an elm badly infested with the larvae. The caterpillars thus had but a few hours of feeding before the storm. The following morning we found 109 caterpillars on the sheet, many of which were dead but some still showed signs of life. The latter, 19 in

number, were collected and placed in a container with unpoisoned elm leaves. Nine recovered and ten died.

A considerable quantity of the dead caterpillars was taken from the sheet, tree trunks and nearby foliage and their bodies analyzed for arsenic by Mr. C. H. Hunt of the Ohio Experiment Station. Mr. Hunt found arsenic present in large quantities, thus precluding the idea that the caterpillars might have been killed by the storm or have died from "wilt" or other disease.

The final notes were taken May 31. Throughout the area which had received the double treatment, i. e., an additional dusting after the rain had washed off the first, the control of the caterpillars was almost perfect. It was difficult to find any living insects, and little additional injury seemed to have been done the foliage. In other words, the treatment seemed to have resulted in excellent commercial control. Since the foliage was damp at the time the poison was applied it "set" immediately and could be found as an excellent coating on leaves taken in all situations.

In the area which had not received the double treatment, there were still on May 31 some cankerworm larvae feeding and the injury to the foliage had progressed somewhat. The application, however, undoubtedly had been of value.

Incidental Results

An unanticipated aspect of airplane dusting was brought out in this test, viz: the consummate neatness of this method as compared with liquid spraying. With the latter there may be serious mutilation of choice plants by trampling of workmen, dragging of heavy hose and the passage of the machine. In many instances this is not a serious matter, but with property like the Severance estate, it is very important that expensive shrubbery, ferns, etc., be uninjured.

When treated by airplane, the only visible evidence of the work was a slight deposit of powder on the foliage which did not in the least disfigure even the most delicate plants and blossoms.

The Casstown Test

Because of lack of time but little of the detail of this test will be given. Briefly stated it consisted in the treatment of a 4-acre catalpa grove of 3500 trees averaging about 25 feet in height. The plot was somewhat in the shape of an L with a difference in elevation of perhaps 70 feet between the top of the stem and the foot.

A part of the grove was bordered by pastures, and a tall double row of maples formed a difficult hazard at one end.

A moderate infestation of the first brood of the catalpa sphinx was present and when the work was done the larvae were but ⅔ grown. At least 4/5 of the foliage was present, hence the leaf canopy was very dense.

Object of the Test

The problem was two fold. 1st: To determine if a single application directed against the first brood larvae would control the insect for the season. 2nd: To determine if the heavy leaf canopy would be penetrated by the dust cloud.

Details of Applying the Dust

The McCook landing field, 20 miles away, was used as a base to operate from. The applications were made June 15 with a gentle wind blowing 2 to 5 miles an hour almost lengthwise of the grove, the flights for the most part being made almost directly into the wind, and at an altitude of 40 to 50 feet directly above the trees.

Because of the height of flight and the narrowness of the grove it was estimated that only about one-half of the 200 lbs. of powder used was deposited on the trees.

An excellent distribution of the poison was procured except in the immediate vicinity of the bordering rows of tall maples and at the opposite end where the hopper was "cut off" too soon in order to prevent the dust falling on the pasture land.

However, with all our care, some poison fell on the pastures but it was found to be comparatively easy to remove this where the grass was short, by dragging over it a small, many branched tree. Where the grass was tall, we dragged over it a thirty foot pole with a heavy log chain looped behind. Both plans jarred the poison from the grass blades and deposited it on the ground beyond the reach of stock.

The Effect on the Caterpillars

The first ailing caterpillar was found 8 hours after the first charge of powder had been released and by 46 to 50 hours after the application of the poison the dead caterpillars were very abundant.

In brief the test was very successful—it destroyed the first brood of worms and prevented the appearance of a destructive second brood and effected a satisfactory commercial control of an outbreak of the catalpa

sphinx. In the two areas mentioned where it was not possible to secure a perfect application some caterpillars survived but these were not numerous enough to restock the grove for subsequent broods.

Some Defects of the Airplane Method of Dusting

As might be expected, with the seasons additional experience some defects in the general proposition of treating tall trees by airplane and in particular of the specific equipment which we used in the work have become apparent.

A general criticism which might be made of the proposition of airplane dusting as a whole is that it is difficult to determine the extent of the area covered by any single passage of the dusting plane, particularly when one is operating on a large woodland. It is hard to designate or mark the treated area so that spaces may not be missed or be double treated with the next passage of the plane.

This trouble would be at least partly and probably largely overcome if certain changes were made in the apparatus. As the installation is now constituted the complete attention of two men is required to liberate the dust. Had the man in the passenger cockpit any time to look about it is doubtful if he could see much because of the dense cloud of dust with which he is enveloped when the mechanism is in operation. If the distributing machinery could be driven by an electric or wind motor, the hopper centrally installed and the dust cloud released at the rudder rather than at the side of the cockpit, the vision of the observer would not be interferred with and he would be left free to note the distribution of the dust over the area under treatment.

It has been suggested to the writer that perhaps one man could pilot the plane and at the same time operate the liberating apparatus if such was mechanically driven but in this I do not agree. In my opinion the entire attention of the pilot is required in flying the ship just as low to the tree-tops as is possible—that the success of the operation depends upon at least moderately low flying and that the services of a second man are essential for operating the distributor and observing the area covered by the dust. The latter cannot be estimated, neither can it be observed from the ground in large wooded areas, and since distribution can be noted from the air only, it follows that either an observer must be in the dusting plane or a second plane must be used for observation purposes. Of the two plans, obviously the most practical is the first named.

Another criticism of the method may be made justly that appropriate

landing fields are not always accessible and that they are less likely to be accessible in the very areas where airplane spraying would be most practicable. With the development of aeronautics, however, not only will progress be made in the perfection of landing apparatus and methods but additional fields will be constructed for the accommodation of the public.

The final defect to which I wish to refer pertains to the type of plane and hopper used. It is the general opinion of those experienced in aviation matters who were connected with this test that the Curtiss JN-6 is not a suitable plane for this work. The writer will not attempt a detailed discussion of this matter but will state that the general opinion seems to prevail that a plane with larger carrying capacity and perhaps of an entirely different type of construction should be employed. It would seem that if a moderately slow plane capable of carrying two passengers and a minimum load of 500 pounds of powder could be had for the work it would much more nearly fill the requirements. This amount of poison should be sufficient for 30 to 50 acres of woodland, and thus it would be entirely practical to use a landing field even as far as 25 miles away if with each flight such an immense territory could be covered.

In addition to the substitution of a mechanically driven release instead of the hand apparatus as previously discussed, the hopper should be equipped for more rapid distribution—I should judge at least five times that of our present machine.

Conclusion

Each season we see some of the more notorious shade and forest insects steadily extending the area of infestation in the United States and at the present time a most serious situation exists in the apparently imminent invasion of some of the great wooded playgrounds of the land. Dusting by airplane at least offers a possible means of check and when one considers the degree of success which has attended the Ohio work it seems highly worth while that this method be given a thorough painstaking trial.

The writer will admit that at first thought the plan seems highly impracticable, but since the work of 1921 and during that of the present season many fellow workers have expressed the belief in no uncertain terms that the method seemed most thoroughly practicable and would stand the test of time. Almost all of the observers who have witnessed the Ohio trials have been highly skeptical before the work was done,

but after seeing with what unbelievable dispatch an area could be covered and with what neatness and thoroughness the treatment could be made, without exception they have become thoroughly converted to the idea.

The next paper will be presented by Mr. A. F. Burgess.

EXPERIMENTS IN DUSTING FOREST AREAS WITH AN AIRPLANE

By A. F. Burgess, *Melrose Highlands, Mass.*

(Paper withdrawn from publication)

Mr. W. E. Britton: I would like to ask if the gipsy moth caterpillars were killed by this method of dusting and whether the experiments will be continued.

Mr. A. F. Burgess: Owing to delay in securing the machine and the equipment, and the bad weather, the dust was applied rather late in the season, and the results showed no effective killing of gipsy moth caterpillars. Data secured was mainly on the distribution of the poison and the general utility of this method of work. At present I do not think it is a practical method in large forest areas. It is possible that the use of a dirigible or a very slow moving machine might be more effective, but the operation of an airplane in large forest areas is simply mechanical and lacks the element of thoroughness that you should have if you are going to do effective work.

Mr. J. M. Swaine: We hope to persuade our Air Service to carry on one or two experiments on a large scale next summer in Western Canada. It seems to me from all I can learn and the experience I have had in the Air Survey work, that the heavier than air machine is altogether too risky for large operations. How high were you flying?

Mr. A. F. Burgess: 50 to 100 feet above the tree tops and the nearest landing place was 12 miles away.

Mr. J. M. Swaine: We cannot get pilots from our Air Service to fly under such conditions. They will not take the chances. There is great danger and if your engine fails, a serious accident will result. Flying a few feet above the tree tops is altogether too risky. With a lighter than air machine you can fly more slowly and the work might be

done satisfactorily. We are going to do our best to try out this method next summer.

MR. A. F. BURGESS: The danger element, I think, has been overlooked to a great extent in connection with this work. I am told by aviators and by others who are well informed concerning aeroplanes, that in ordinary cross-country flying they keep away from forest areas, unless the machines are at a high altitude; that is because they are more apt to encounter bad air currents. I was very thankful when the experiment was over and no one was hurt. New England is recognized as a very bad country to fly in. It is rough and broken, rather heavily wooded, and favorable landing places are very scarce.

MR. E. P. FELT: I hope something will be done along this line because it seems to me that if we are going to attempt to hold the gipsy moth in New York, it may be necessary to poison extensive wooded areas to the east. I believe the method ought to be tested thoroughly, probably with a lighter than air machine.

MR. A. F. BURGESS: This matter is under consideration and we hope to do something along that line another season.

MR. J. S. HOUSER: In our consideration of this method we should remember that these are initial trials conducted with a primitive type of apparatus and without experience in the manipulation of the machine. It is unfair to pass judgment on its ultimate value by comparing it with our present day highly developed solid stream liquid machines which are the result of years of experiment and study. If we must make comparisons, let us compare this, the earliest aerial duster with the earlier types of liquid sprayers.

In the treatment of large forest areas, it is doubtful if it would be advisable to fly crosswise of the wind, but rather to head directly into the wind. The distribution of the powder thus would be much narrowed down and would permit one to fly much higher.

Another point is that we need a hopper with a much increased distributing capacity which would permit a sufficient degree of concentration even though one flew higher.

I know it is hazardous to fly low, but as I crossed the Berkshire Hills on my way to Boston, I wondered how it would be humanly possible to use a liquid sprayer under such very formidable conditions. Since the time seems near at hand when something must be done by way of insect control in this rough, broken area, does not the aeroplane duster offer more hope than any other method in sight at the present time?

It seems worth while that we extend every effort in exhausting this possibility.

MR. D. F. BARNES: The relation of direction of flight to wind direction has been brought up. The area to be treated is a fixed factor; the wind direction variable, changing from hour to hour. If treatment of an area has been undertaken and a certain direction of the lines of flight established the only variations possible to compensate for changing winds are to vary the distances between the lines of flight or to change their direction. In a wooded area, with no distinctive features this is difficult. Either of the changes may give unequal distribution but the change in direction will, dountless, be more disturbing than the change in spacing. We know that the wind may vary as much as 180 degrees in an hour but in spite of that we must have even distribution of the poison if the insect is to be controlleed.

JOINT MEETING, AMERICAN PHYTOPATHOLOGICAL SOCIETY AND AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Professor E. C. Stackman, President of the American Phytopathological Society, called the meeting to order, and stated that the phytopathologists were very happy to meet again with the entomologists in joint session.

PRESIDENT E. C. STACKMAN: The first paper on the program will be presented by Mr. C. L. Marlatt.

THE WHEN AND WHY OF PLANT QUARANTINES

By C. L. MARLATT

ABSTRACT

A review was given of important legislation in different countries of the world in relation to plant pests. After brief reference to the existence of ancient legislation, an account was given of the European legislation with respect to the Phylloxera, culminating in the Bern Convention of 1881, and with respect to the potato beetle, dating from 1875 when this pest obtained its first foothold in Germany. Other European embargoes were also discussed, such as that of Great Britain, on account of certain gooseberry and currant diseases.

A sketch of similar legislation in the United States was given, beginning with an account of the grasshopper laws of the late 70's, enacted by the States of Kansas, Missouri, Minnesota and Nebraska. It was pointed out that California was probably the first State to undertake comprehensive legislation, in its law of 1881. A review was given of subsequent State legislation which involved up to 1895 only four States, in addition to those previously listed, namely, legislation by Washington, Oregon, Idaho, and Colorado, as indicated in a compilation in Bulletin No. 33 of the Bureau of Entomology. The compilation of State laws up to 1898 (Bulletin No. 13, new series, Bureau of Entomology), indicated that 15 States had at that time general legislation against insect pests, and that 8 States had foul brood legislation. The next edition of State laws (Bulletin No. 61, 1906) recorded legislation by practically all of the States of the Union. This tremendous increase of legislative activity resulted from the spread of the San Jose scale in the eastern States, and is the origin of most of the existing State laws and regulations governing movement of nursery stock, etc. Various European plant embargoes and other legislation on account of the San Jose Scale of the same period were described. Reference was also made to the considerable legislation which has resulted in the South on account of the boll weevil and more lately on account of the pink bollworm.

A brief history was given of the effort in 1897, on account of the San Jose scale, to secure national legislation, the main object being to safeguard the interstate movement of nursery stock, but making minor provision for inspection of imported stock at designated points of entry, or in lieu thereof for the acceptance of foreign certification. The reasons for the failure of this effort were pointed out and a brief discussion was given of the inception in January, 1909, and the final enactment August 20, 1912, of the present Federal Plant Quarantine Act.

Reference was made to the plant pest legislation participated in by many foreign countries, and particularly by the English and French Colonies, where the necessity existed, similar to that in the United States, for protection from the older centers of civilization. It was pointed out also that our own Plant Quarantine Act had resulted in complementary legislation providing for inspection and certification of exports by some 32 foreign countries.

PRESIDENT E. C. STACKMAN: The next paper is by Mr. W. A. Orton.

BIOLOGICAL BASIS OF FOREIGN PLANT QUARANTINES

By W. A. ORTON, *Washington, D. C.*

(Withdrawn for publication in Phytopathology)

PRESIDENT E. C. STACKMAN: We will now listen to a paper by Mr. W. A. McCubbin.

FACTORS IN THE SUCCESS OF DOMESTIC QUARANTINES

By W. A. MCCUBBIN, *Bureau Plant Industry, Harrisburg, Pa.*

ABSTRACT

Four features of domestic quarantines are discussed—(1) The legal aspect involves consideration of an adequate basic law, a well organized and capable staff, and an emergency fund to meet sudden cases. (2) The quarantine should be given close attention by the scientist from the viewpoint of the administration. (3) In quarantine methods emphasis is placed on the need for extensive and intensive surveys at the outset, and for emergency research to provide a basis for a permanent policy. Stress is also laid on the need of well planned methods and adequate machinery and the importance of fairness and strictness in enforcement. The official in charge of enforcement should be a man of high ability. (4) The public judges quarantines on the fairness and reasonableness of the enforcement rather than on the severity of the restrictions. Quarantine measures are more easily enforced in populations with a high average intelligence and a well developed sense of public duty. After one successful quarantine experience in a district a second is accepted with less reluctance.

The time has probably arrived when it will pay us to take stock of the whole domestic quarantine situation, and from past successes and failures derive those lessons which will enable us to meet future problems with greater confidence. St. Augustine states that, "Out of our errors we make unto ourselves a ladder by which we climb." That there have been errors in the past we admit, but to keep a just perspective of the situation, the past successes must also be considered. And when the curtain is lifted and we see past accomplishment as a pitiful effort and past failures that appear inexcusable, let us not forget that what we see clearly in the glaring light of present day knowledge was carried out in the days of feeble candle power. Without underestimating the success or overestimating the failure let us rather proceed with judicial mind to examine them both for such help as they can give us for further effort.

It would make an attractive study to arrange all our internal quarantines in a proper classification and subject them to careful analysis, so

that from the charted results future action could be predicted with the certainty that one has in the extension of a known curve. Perhaps the material available is too fragmentary to respond successfully to such mathematical treatment; at any rate such an exhaustive study is beyond my present reach and I shall content myself with pointing out some features of domestic quarantines as they concern (1) the legal aspect of quarantines; (2) the viewpoint of the administration; (3) factors in the quarantine itself; and (4) the relation of the public to quarantines. If these features are afterward subjected to more detailed discussion the purpose of this paper will have been attained.

The Legal Side of Quarantines

In days gone by many difficulties were encountered in regulatory work because of the lack of full legal authority. These difficulties did not arise so much in connection with state functions which could be planned and arranged for long in advance, but rather in those cases where sudden action was necessary. In such cases the state frequently found itself without power to stamp out a pest. This hampering situation gradually has been improved, at first by the granting of legal power for specific cases and latterly by the adoption of more general basic laws. At the present time the necessity of reserve power to be used in an emergency is so generally recognized, that in one form or another blanket power for establishing quarantines exists in nearly every state.

Under our form of government it has always been considered dangerous to place arbitrary power in one man's hands, except for the performance of a specific and definitely limited act, and the idea of a blanket law granting a wide range of power to be applied at the discretion of some official, met with great opposition. But the awkward situations that have developed and the increasing requirements for pest control have gradually weakened opposition to the basic law plan, until the principle may be said to be now completely accepted. This change of viewpoint was made easier by a realization that quite adequate checks on the unwise or unjust use of arbitrary authority easily may be provided. It is realized that officials are quite unlikely to jeopardize their position and personal reputation by unwise or unjust use of power; that restraints involving "third-party" boards or committees are satisfactory; and that the public itself carries in its million hands the final check of an implacable vote.

When compared with past conditions the present situation is gratifying. Our ideal of an ample basic quarantine power in each state is

fast being realized. Henceforward the crop protection watch dogs may be expected to roam free, ready at a moment's notice to deal with each unfriendly intruder, instead of being confined by the chain of inadequate legislation, at the end of which chain they could bark but not bite.

It should now be added that such a law can only function with full mobility, if it is entrusted to a well-trained and capable staff. The size of this force may vary for different conditions, but it should be so organized that, like a skeleton army, it can be promptly enlarged and extended in any direction to meet all sorts of emergencies. With a basic law and an efficient staff, there still remains one other feature to complete this trinity of legal factors. It is an emergency fund, without which the most faithful and energetic body in the world will be utterly helpless. This has always been a difficult matter to procure, and various administrations have solved it differently, when need arose unexpectedly. The makeshifts, subterfuges and juggling of finances that have been found necessary to meet emergencies are strong evidences that the setting aside of a definite emergency fund is a desirable thing to plan and work for in every state.

A great deal could be written on the legal bearing of numerous quarantine details. There might be considered for example, the wording of a quarantine so as to accord with, and keep within the authority of the basic law; the fixing of responsibility for violation; delimitation of areas so as to correspond to known political subdivisions or in some other simple manner easily verifiable; the position and legal status of employees, agents, and common carriers in respect to the quarantine; the delegation of authority to agents; the necessity for drawing up regulations so that they will include every type of situation that is likely to arise, will be clear to the public, and will exhibit that sweet quality of "reasonableness" so dear to the legal mind; the desirability of having these regulations so arranged that any violation can be established in a simple and definite way; of having them so worded that they and the violations of them will be easily understood by magistrate, judge, or jury; the necessity of having each indictment or information free from error and the evidence clear and incontrovertible; the question of whether violations shall be taken into court or regarded as cases of summary trial before a magistrate or justice of the peace.

While these and numerous other similar points are not properly the field of the scientist, yet they are the materials of which the quarantine fence is constructed. He who understands the purpose of such a fence

and can also supervise the building of it, is the more likely to have a barrier which is not only pest-proof but violation-proof.

The Quarantine and the Administration

A second phase of the quarantine question relates to the viewpoint of the administration. The board or official entrusted with the legal power to erect and enforce regulatory measures may be regarded as a Janus-headed individual, with one face toward the public and the other turned to his scientific staff. Naturally he will have an attitude of mind slightly different from that of the scientist, since of necessity he is compelled to think on both his fronts.

When a quarantine is considered in regard to any pest or disease the single track mind of the scientist runs thus: "We can keep this pest within bounds by applying a quarantine." The mental attitude of the administrator is, "Is it necessary to do this? Could a system of inspection be devised to take care of the stiuation? Would a campaign of education serve the purpose? Can we make the quarantine effective if it is applied? Will the results justify the expenditure of money, the disturbance of agriculture and trade, and interference with individual freedom?"

Past performances indicate that this Missourian attitude of mind may inevitably be expected from the administration; hence it is of vital importance that in the early stages of the problem its various factors be subjected to clear thinking and careful weighing, and that close study be made of the effects that are likely to follow upon the interjection of a new and disturbing force into the domain of public interest.

Factors for Success in Quarantine Methods

We may next turn to some features of the quarantine itself. Let us suppose that in a state where the legal authority and administrative functions have been amply provided for, a new insect or disease makes its appearance. Hasty observation indicates that the pest is likely to be important and that a quarantine is required. It would seem that under such conditions no difficulty could arise. But our past experiences show that in the placing of such a quarantine there are likely to be two points of weakness.

The first involves the extent of infestation. Until that is known with some accuracy a quarantine may be merely an empty gesture. It may be argued that in such cases a chance has to be taken, that the necessities of the situation demand immediate action even at the risk of seeming to

have done an unnecessary or inadequate thing. This is valid reasoning as far as it concerns the past; but since we are today endeavoring to look forward rather than backward it is more appropriate to think in terms of future plans than in criticism of what has been. From this viewpoint the constructive thought that suggests itself is the extreme importance of plant disease and insect surveys in connection with the incipient stages of quarantines. We might venture to mention some cases which illustrate this point. The White Pine Blister Rust exemplifies clearly one extreme. In 1917 the United States and the Canadian Government drew quarantine lines north and south through the prairie region, forbidding the passage westward across this line of materials likely to carry the disease. The object was to protect the western pine region from the Rust which at that time had not been found there. In 1921 and 1922 the disease was found widely spread in British Columbia and the adjacent State of Oregon. We cannot help seeing now that at the critical period adequate provision was not made for scouting the western area. Similarly in the case of the Mexican Bean Beetle an area including several counties was quarantined, but later on this insect was discovered in several other distant localities and the quarantine had to be abandoned. Many other like cases will occur to everyone who is familiar with the past records. Leaving out of our thought entirely any consideration of the policy or methods involved,may we not draw from these cases the clear lesson that scouting and survey work on both extensive and intensive scales are of the highest importance, and should be intimately correlated with quarantines, either before they are actually placed or as soon as possible thereafter.

During the last few years the survey situation has been vastly improved by the development and organization of special Federal agencies for survey work, and these have been correlated with State forces so as to function in an admirable manner. The methods and extent of the surveys in the Potato Wart problem, to mention only one of many, indicate the help that may be given to a quarantine problem by prompt and adequate surveys. The future holds promise that when a new pest or disease appears we shall be able to marshal forces large enough to locate the extent of the infestation with a promptness and accuracy that have not been possible in the past.

The second of the weaknesses referred to is the matter of what may be termed emergency research. When an economic pest appears we are suddenly confronted with the necessity for rapid decision, involving

one of four things,—eradication, isolation, control, or merely watchful waiting.

In making this decision we are first of all hampered by unfamiliarity with what is usually a foreign pest, and by our inability to foretell its possible capacity for damage; there are also our own human limitations to be considered. Given enough time the facts can be ascertained and the decision made, but many such problems are extremely urgent and deserve speedier solution than can be given by the leisurely work of one or two investigators who are too often young or inexperienced men. What such cases most need is "first-aid" research, the kind that gave Edison the incandescent lamp, the kind that builds a bridge out of a barb wire fence or patches a tire with spearmint.

When a decision of the kind referred to is required, we ought to be able to turn loose on it at once an energetic force with both the numbers and ability to get enough of the vital features of life history and habits to enable us to decide our future course. In the past, and to a large extent still, funds, organization, and perhaps we should add, generalship, have been inadequate for concentrated activities of this kind. But there is no reason why we may not plan for the future an organized method of bringing large-scale, intensive effort into action for the quick solution of emergency problems of this nature.

Going on from these weaknesses in the establishment of a quarantine, to the methods of the quarantine itself, there is one feature that deserves emphasis. It is the vast difference between a paper quarantine and a real one. However deeply a government official may reverence the grandeur of his own authority, unless he takes adequate means to enforce his promulgation only a few conscientious souls will pay any attention to it. It is perhaps going too far to say that no quarantine should be issued for which no provision is made for enforcement, but the truth of the matter is that *real* results from any quarantine are due to the watchful, active field man rather than the central office. To erect a quarantine without providing the machinery of enforcement is too much like trying to carry water in a sieve.

Of almost equal importance is the policy that the means and methods of enforcement shall be adequate to the desired end. To use a homely proverb one should not send a boy on a man's errand. This does not mean that all quarantines require the same rigid and absolute type of enforcement. In many cases complete isolation of a pest is impossible, or at least impracticable, and the only thing that can be done is to lessen or delay its spread. But whatever the degree of restriction aimed at,

the enforcement should observe the fourth rule of warfare which states,—"If a detachment is sent for a particular purpose enough should be sent to accomplish the mission." Lack of funds is and always has been our excuse for indifferent enforcement but it is worth consideration whether a less ambitious program for which adequate facilities are available would not in the end be a better policy than planning a man's work and sending a boy to do it.

Concerning quarantine regulations and their application it need only be said that, the simpler rules can be made the more easily they will be understood; and that if they are expressed as a prohibition of some definite act, the doing which may be easily established by witnesses, or by some "corpus delicti" of material evidence, they are more easily made the basis of prosecution. It goes without saying that such rules should be broad enough in scope to cover all kinds of cases, and should not discriminate between any individuals or groups. Finally if these regulations are not administered with fairness and impartiality the public is sure to get into such a frame of mind that the sooner the inspection staff is equipped with chain armor the better.

Nearly all successful quarantine work in the past has been successful largely because of the character of the official in direct charge of the details, and his staff. Program and organization may be good and funds sufficient, yet the results may be disappointing on account of the quality of enforcement. To be successful in directing a quarantine is a high tribute to ability, since this work calls for a man of no ordinary caliber. He must be well trained, energetic and faithful; he must possess good judgment and be resourceful in emergencies; be methodical, punctual and accurate; above all he must have a stout and rigid backbone and a tough skin tightly stuffed with sand; how can one expect such a man to be also tactful, gentle and courteous? Yet these sympathetic qualities are as necessary as the sterner ingredients if this work is to run smoothly. In short it takes a big man to enforce even a little quarantine. As this man is so should his assistants be, and if he is of the type mentioned, we can safely say, so will his assistants be.

The Quarantine and the Public

The reaction of the public to quarantines is a matter of much concern to us. Plant quarantines may be considered as belonging among the highest expressions of civilized life in that they involve a definite restriction or interference with individual liberty for the common good, not on moral grounds, not because of humanitarian considerations, but

on a purely economic basis. In this respect they are clearly related to the right of eminent domain and other similar functions of the state where a measure of liberty is withdrawn from the individual for the benefit of the public at large. Having a solely economic basis it is often somewhat more difficult to arouse the public to their support than where moral or humanitarian issues are involved. For in the threefold relationship which the public bears towards quarantines, it may be expected that those on whom the restrictions fall will be antagonistic and those whose interests are not affected either way will be indifferent, while to those who may be presumed to profit by the measure the benefits are usually too distant or intangible to stir much thought. But if any particular quarantine, or the quarantine idea in general, is to be successful, it is important to secure the backing of popular support both in the group which is benefited and among public spirited citizens outside this group.

The important feature for obtaining a favorable judgment from the public is after all the justness of the measure. Most quarantines are so simple in plan and so direct in method that when these are properly explained the average man accepts them as right and reasonable. With a program of popular education, news articles, and special efforts to reach those influential and public spirited elements in the community who have so much to do with molding general opinion, it ought not be difficult to awaken in the public an attitude of mind which may fall short of enthusiasm but which will at least guarantee intelligent acquiescence.

By way of parenthesis it may be noted that public interest, which always underlies support, is more easily roused in cases where the problem or the method of solution possesses what may be termed the dramatic quality. The White Pine Blister Rust has always been easy to get into the public ear, while appeals in prosaic cases like the Late Blight of potato, pass unheeded. In getting a quarantine before the public the use of whatever dramatic possibilities it may possess should not be overlooked.

It is not always a simple matter to create a favorable public sentiment, but it is terribly easy to destroy it. At best the public regards quarantines with mere toleration, as a necessary evil. This lukewarm favor can be alienated very quickly if there is negligence, unfairness, or discrimination in carrying out the work. Unless the rules and regulations are drawn so as to be reasonable and fair, and unless equality of treatment is rigidly accorded to all, public confidence will vanish like flax in a flame. The critical and all-seeing eye of the public

is ever alert for any glimpse of weakness or laxity, and standards of efficiency that might arouse little adverse comment in other administration affairs would here be subject to the bitterest condemnation.

A whole community will submit to fair and just restrictions with a few grumblings, but a falling down in enforcement so as to give the semblance of discrimination or favoritism rouses at once the wildest resentment. The public taste does not relish a quarantine diet, but when the dish is ordered they will eat it if it is well cooked and well served.

The type of population to which a restrictive measure applies is a feature that has to be taken into consideration. An intelligent progressive community which can understand the benefits to be obtained and in which the sense of public duty is well developed is obviously more likely to assume the necessary burden than an illiterate group which can not comprehend the beneficial aim and has but a feeble sense of social responsibility. Perhaps never in our quarantine efforts has there been a more extreme case in this respect than in the Pennsylvania Potato Wart Quarantine. This quarantine had to be applied to a population largely made up of diverse foreign elements all of which have low educational standards and show so little interest in public affairs that newspaper publicity is of small value. Ordinary methods would have failed entirely. The language obstacle, the mental inertia and the obstinacy of the ignorant here constituted a problem that has required the most patient, persistent and methodical work.

That this quarantine has been maintained with a strictness of enforcement rarely reached elsewhere, against the universal opposition of a large population and under the language and educational handicaps mentioned, is an accomplishment which inspires confidence in our future work. For a quarantine will seldom encounter such adverse conditions in any population with which it may have to deal.

Regulatory work has another phase in relation to the public. The success or weakness of each quarantine does not pertain to itself alone but has a definite effect on future efforts. A quarantine is a community experience; if the community memory of such an experience is that of a disagreeable task planned with care and carried out with thoroughness, fairness and tact, then the community will submit more readily to a second necessary restriction. But a few experiences associated with indefinite purpose, ill-considered plans, haphazard, irregular methods, and jarring personal contacts, will destroy to a large extent the valuable educational development which a series of quarantines should provide,

and which should make each succeeding measure easier to participate in for all concerned.

In conclusion I would present for further discussion a summary of the above mentioned factors that are concerned in the success of domestic quarantines.

(1) The desirability of a basic law providing ample power to deal with emergencies, whether these involve considerations of time or place or magnitude.

(2) For enforcement of this law there should be maintained ready for action a well-trained staff, not necessarily large, but so organized as to be readily extensible in any direction.

(3) An adequate emergency fund should be maintained for sudden use.

(4) Adequate survey work should be intimately and promptly correlated with every quarantine.

(5) Provision should be made for emergency research so that through extensive and intensive effort there may be quickly obtained data sufficient to form the basis of a permanent policy.

(6) The quarantine plan should include at the outset sufficient means, enough men and such careful methods that its success will be assured.

(7) Quarantine regulations should be simple, clear, and not discriminatory.

(8) The personnel of a quarantine staff is an important factor in its success; hence direction of this work should be entrusted only to men of outstanding ability.

(9) The public eventually judges a quarantine by the fairness, impartiality and thoroughness of enforcement rather than by the severity of the restrictions.

(10) Popular support is a valuable aid to success and to obtain it much effort of an educative kind is worth while.

An Exotic Coccid Taken in the United States. *Nipponorthezia ardisiae* Kuwana was taken in the nests of mound building ants by the writer near Rockville, Pa., on Feb. 14, 1921. Specimens were determined by Mr. Harold Morrison, U. S. Bureau of Entomology, Washington, D. C., who reports the scale as a native of Japan on the roots of *Ardisia japonica*. This represents a genus heretofore unknown on the North American continent.

F. W. TRIMBLE

PRESIDENT E. C. STACKMAN: The next is a paper by Mr. Wilmon Newell.

TROPICAL AND SUB-TROPICAL QUARANTINES

(Summary)

By WILMON NEWELL, *Gainesville, Florida*

ABSTRACT

Quarantines to prevent the introduction of insect pests and plant diseases from foreign countries are of prime importance. The southern states are more vitally concerned with quarantine protection than are the northern states as insects have, in the South, a large number of host plants and control measures must be applied during a longer growng season. The Federal Horticultural Board is the mainstay of the country in the maintenance of effective quarantines and while its work has been invaluable and its accomplishments significant it is still far short of what it should be. Education of the public as to the importance of quarantine protection and more liberal appropriations for the work of the Federal Horticultural Board are urged.

Quarantines against foreign insect pests and plant diseases assume importance in proportion to (1) the degree of danger of their introduction and (2) the opportunities presented by existing conditions for the increase of, and damage by, any given insect or disease after its introduction and establishment.

Officials and residents of the interior states have not, as a rule, appreciated the importance of quarantine protection, perhaps on account of their not having had the opportunity to observe at first hand the numerous avenues through which pests may be introduced. Such quarantine protection is, however, of vital importance to the interior as well as the coastal states. Serious losses to the crops or fruits of one section of the country are, in the last analysis, felt by all. Destruction of the citrus fruit crop of California or Florida, for example. would be followed by a higher price to the consumer for apples, peaches and other fruits. Also, a pest established in one state finds many opportunities for spread to the other states.

The southern states are more vitally affected by introduced insect pests than any other portion of the country. This is true, not necessarily because an insect species, *per se*, is any more destructive under southern conditions than under northern ones—and this is a point which we do not concede—but because there is in the South a greater number of injurious species and the addition of each additional one but adds to the load which must be carried by the farmer and fruit grower; because the larger number of possible host plants increases the difficulty of applying control measures and because the longer growing season for crops makes necessary a greater expenditure and more continuous effort to maintain a

status of control. Whether plant diseases are more destructive in the South than in the North is a question which can best be answered by the phytopathologist.

As our experience with quarantines has been limited to Florida we can discuss them only from the standpoint of Florida's experience, but it seems safe to conclude that what applies in the case of Florida will also apply, in more or less degree, to all southern states.

The plant quarantine work in Florida was commenced in 1915 and since its inception has been conducted in close cooperation with the Federal Horticultural Board. Inspectors of the State Plant Board of Florida, engaged in quarantine work, hold appointments as collaborators of the Federal Horticultural Board and enforce the quarantine regulations of the latter Board as well as of the State Board.

In the case of some pests, the federal regulation is considered as amply sufficient but in other cases the federal regulations are supplemented by state regulations which, it is thought, add to the protection afforded to Florida alone. In still other instances the state maintains quarantines, which are of importance to Florida only and which deal with insects or diseases of which the federal regulations do not take cognizance.

While the quarantines are intended to guard against the introduction of a very large number of foreign pests, the following may be mentioned as the most important:

The Mediterranean fruit fly (*Ceratitis capitata* (Wied.)) from Bermuda, Hawaii and other countries, the West Indian fruit fly (*Anastrepha fraterculus* (Wied.)) from the West Indies, Argentine, Brazil, Chili and other Central and South American countries, the Mexican orange maggot (*Anastrepha ludens* (Loew)) from Mexico, the pink bollworm (*Pectinophora gossypiella* (Saund.)) and the black fly (*Aleurocanthus woglumi* Ashby).

The amount of inspection work performed at the Florida ports from Dec. 13, 1915 to April 30, 1922, is summarized in the following table:

	1915-16	1916-17	1917-18	1918-19	1919-20	1920-21	1921-22	Total
Foreign vessels.....	166	1240	1777	1724	2458	3035	2255	12625
Total vessels.....	370	3257	4253	3485	4504	4948	4179	24996
No. packages received by boat, express, freight, mail, etc.....	500	3105	3422	69985*	336059¾	710413	1333333	2456817
No. packages returned.....	18	255	485	1521	4936½	2130½	2610	11596
No. packages destroyed.....	69	1182	1037½	1743¾	2345½	1564¼	1757	9678

*Prior to August 1, 1918, horticultural material inspected was reported by "shipments." A "shipment" might contain any number of packages. Subsequent to the above date reports were made of the number of packages or containers.

Space does not permit of listing the many insects intercepted in the course of this inspection work. In the case of Coccidae alone, the following species, either unknown or of very limited occurrence in the United States, may be mentioned: *Aspidiotus destructor* Sign., *A. fabernii* Houser, *A. palmae* Morg. & Ckll., *A. subsimilis* var. *anonae* Houser, *Asterolecanium miliaris* Bdv., *Lepidosaphes hawaiiensis* (Mask.), *Pseudaonidia articulatus* (Morg.), *P. tesserata* (DeC.), *Pseudischnaspis alienus* (Newst.), *Pseudococcus sacchari* (Ckll.), *Targionia hartii* (Ckll.), *T. sacchari* (Ckll.) and *Vinsonia stellifera* (Westw.).

Among the quarantines maintained by Florida to prevent the introduction of insects or diseases from other states may be mentioned those designed to prevent the introduction of citrus canker, brown rot of lemons and oranges, the Japanese camphor scale and the Mexican bean beetle.

A glance at the map of the United States here shown tells us immediately that the United States is not receiving adequate quarantine protection. We see that inspectors of the Federal Horticultural Board are stationed at Boston, New York, Philadelphia, Baltimore, Washington, New Orleans, Brownsville, Laredo, Eagle Pass, Del Rio, El Paso, Nogales, Calexico, Seattle and Portland, Oregon; also that collaborators of the Federal Horticultural Board are located at Newport News, Jacksonville, Miami, Key West, Tampa, Pensacola, San Diego, Los Angeles, San Piedro, San Francisco and Eureka but that the following ports are entirely without inspection service: Portland,(Maine,)Wilmington, Charleston, Savannah, Brunswick, Mobile, Gulfport, Galveston and Port Arthur. In other words, the quarantine fence around the United States consists of a few posts, with numerous gaps between. Surely such an arrangement falls far short of giving adequate protection. One has but to note the vast amount of dangerous plant material constantly arriving at any port of the United States to realize this.

No stigma attaches to the Federal Horticultural Board for this situation. To the full limit of its available resources, the Board's work has been thorough and efficient. The plain truth is that the Board has never had even reasonable financial support from Congress. When we recall that the great majority of the insects and diseases which occasion annual losses aggregating millions of dollars are introduced ones and when we recall our experience with such things as the Gipsy moth, white pine blister rust, Japanese beetle, Japanese camphor scale, citrus white fly and citrus canker, we can only marvel at the lack of foresight

being displayed by our national government in affording protection against more, and still more, of these destructive agencies.

The time has arrived when entomologists and phytopathologists should cease to regard the work of the Federal Horticultural Board as a mere routine activity. We have had too much of the "Let George Do It" attitude. Let us proceed without further delay to educate officials and citizens throughout the country to the importance of more adequate protection against foreign pests. This means that we must secure much greater support, morally and financially, for the Federal Horticultural Board.

PRESIDENT E. C. STACKMAN: Mr. Lee A. Strong is not here but has sent his paper, and a summary will be read.

WESTERN VIEWS ON PLANT QUARANTINE

By LEE A. STRONG, *Sacramento, California*

ABSTRACT

Quarantine power should only be invoked for the purpose of preventing the spread or introduction of a pest. When placed, a quarantine should be fairly and impartially enforced. To prohibit by proclamation does not prevent. Proper enforcement of a quarantine requires adequate enforcement machinery. The promulgation of a quarantine does not remove but apparently stimulates the desire to transport prohibited material. All carriers of plant products should be brought under regulation. Uniform quarantine action should be adopted by states and localities having common interests. Frequent meetings of quarantine officials with full discussion of mutual problems encourages equitable quarantine enforcement and tends to eliminate any spirit of retaliation. This has been demonstrated by the deliberations and actions of the Western Plant Quarantine Board.

It has been wisely said that no quarantine should be placed when inspection could with equal assurance, prevent the introduction of a pest. Once placed, a quarantine should be fairly and impartially enforced. Abuse of executive power will, sooner than any other factor, bring law enforcement into disrepute and jeopardize the entire fabric of laws designed and intended to be beneficial. The use of quarantine should not be invoked for its facility as an inspection measure, but for its value and necessity as a safety and protective measure. Another vital point in the placing of a plant quarantine is the importance of providing the proper and adequate machinery for prompt and full enforcement. Probably nothing has so materially weakened the support which should be accorded the general principles of plant quarantine as

the practice of issuing a prohibitive quarantine without making provision for compelling compliance with the prohibiting order. Too often the state entomologist or the state quarantine official writes a quarantine prohibiting the movement of a certain plant product out of a given district or into a given district, and then sits complacently in an office apparently either nursing the idea that the quarantine will automatically enforce itself, or placing an unjustified faith in human nature in the belief that in writing "Thou shalt not," he has effectively and finally dissipated any desire individuals or companies may have had to even attempt to move any article restricted by the quarantine. Plant quarantines are issued for the single purpose of preventing the introduction and spread of pests. They are necessarily placed because there is a desire to transport the particular plant products which are by the quarantine restricted in their movement. To prohibit the movement of a certain product in no wise discourages the desire to move the product! As a matter of fact, it often has the opposite effect and stimulates a desire to move the product even if it becomes necessary to resort to surreptitious methods to evade the quarantine and accomplish the purpose.

All these factors should be carefully considered before a quarantine is placed. If compliance with the regulations will be so burdensome on all agriculture as to cause the quarantine to be more burdensome than the pest quarantined against, then it is unquestionably wise not to use quarantine. In other words, the cure should not be made more deadly than the malady. California believes, and has believed for many years, in the wisdom, justice, and efficacy of plant quarantines. The Western States as a body believe in it, and the Federal Government believes in it. The effectiveness of a quarantine, however, as previously stated, depends entirely on the possibility of enforcement and the ability to realize the possibility. Quarantine enforcement in California has been made possible by the control of all shipments of plant products on arrival at points of destination. The state quarantine law provides that any person, persons, firm, or corporation who shall receive, bring, or cause to be brought into the state of California, any nursery stock, plants, trees, vines, shrubs, scions, buds, fruit, vegetables, or seed, shall, immediately after the arrival thereof, notify the State Department of Agriculture or Deputy Quarantine Officer or Quarantine Guardian of the district or county in which such nursery stock, etc., are received, of their arrival, and hold the same without unnecessarily moving the same or placing such articles where they may be harmful, for the immediate

inspection of such Director of Agriculture or Deputy Quarantine Officer or Guardian. This law places squarely upon the transportation companies at point of destination the responsibility of holding all plant products arriving in California until they have been properly inspected and passed. Naturally, the law does not contemplate the indefinite holding of perishable commodities; and the law assumes that the commodities shall and will be promptly and properly inspected and disposed of. It has been found that the interest of the transportation officials is equal only to the interest manifested by the quarantine officials. Inspections must be prompt. Calls must be frequently made to remind the transportation official of his duty. The same condition applies at post offices. Common carriers should not be subjected to restrictions not equally binding upon the Post Office Department.

In this connection, probably no carrying or transporting agency has shown a greater desire to cooperate in plant quarantine enforcement than the Post Office Department. That all states of the Union do not take full advantage of the opportunities afforded by the Post Office Department for inspection of plant products in the United States mails is to be regretted. While a degree of quarantine enforcement is in a certain measure desirable and effective, full and complete enforcement is in every way desirable, and certainly vastly more effective than a partial enforcement. It is also true that if common carriers are forced to comply with quarantine regulations while plants move freely and without hindrance in the way of inspection in the mails, it not only constitutes discrimination against common carriers, but encourages and assists in the defeat of the purposes of plant quarantine, since shippers and receivers of plant products will most assuredly forsake the common carriers for the less restrictive channels of the United States mails.

Of what real value is plant quarantine? Doctor Marlatt has repeatedly pointed out that our most serious pests have been introduced into the United States by incidental shipments of plants which were of no real economic value, and which should have been, and would have been excluded, had there been legal national authority for such action prior to the passage of the plant quarantine act. The fact that no pest of major importance has become established in the United States since the passage of the Plant Quarantine Act demonstrates in a graphic manner the value of plant quarantine to the United States as a nation.

As to the value of quarantine to a state, California has believed in the wisdom of quarantine action for many years, and by reason of judicious use of quarantine power, has succeeded in remaining free from many

pests now causing serious damage in other states and countries. Proof of the value of quarantine to California lies in the fact that, despite the favorable conditions in that state for pest establishment, the products of California, with one or two very minor exceptions, are accorded an unchallenged entry to the markets of the world. Believing that what is to the benefit of an individual state is beneficial to a group of states comprising a section where conditions are more or less similar, G. H. Hecke, Director of Agriculture of California, in 1919 called together the quarantine officers of the eleven western states, British Columbia, Hawaii, and the northern district of Lower California, and formed the Western Plant Quarantine Board. The object and purpose of this organization is set forth in clear terms in the constitution of the Board as follows:

> "It shall be the purpose of this organization to secure a greater mutual understanding, closer cooperation and uniformity of action for the efficient protection of our plant industries against plant disease and insect pests."

There is contained in that section of the constitution of the Western Plant Quarantine Board a declaration of the principles of the entire West, in so far as plant quarantine is concerned. This principle obligates any individual state to properly quarantine against pests within its own borders for the protection of another state and to enforce the quarantine with the same regularity and vigor as would be the case if the quarantine were directed against any other state. This is not only an action in good faith, but it is an action which in many cases keeps the markets open for plant products from non-infested portions of the state.

Quarantine officers of the West are greatly disturbed by the failure of eastern and some of the southern states to promulgate and enforce quarantines against serious pests which now exist in certain localities. Absence of quarantine action or lax enforcement of existing regulations causes every shipment of plant products not certified by the Federal authorities to be viewed and probably treated as an undesirable and dangerous importation. This suspicion exists not only in the minds of western quarantine officers, but in the minds of officials in at least a few states in other sections of the United States. The suspicion grows and finds expression in quarantine action proportionately as the value of plant quarantine is recognized and its principles adopted by individual states. It is a suspicion which should not be permitted to grow; it should be dissipated; it can be dissipated when the various states of the Union adopt proper plant quarantine practices.

PRESIDENT E. C. STACKMAN: The papers are now open for discussion.

PROFESSOR WETZELL: I have nothing to offer in the way of discussion, but would like to state that I have very good reasons for believing that the fireblight, *Bacillus amylovorus* is not a native of North America. I have considerable circumstantial evidence to prove that it is not. I hoped to have this ready for this meeting but have been unable to do so.

MR. R. KENT BEATTIE: Where does it come from?

PROFESSOR WETZELL: I have reason to believe it is Asiatic.

Adjournment, 12:30 p. m.

Afternoon session, Saturday, December 30, 1922

The meeting convened at 1:30 p. m., President Sanders presiding.

PRESIDENT J. G. SANDERS: The first paper will be presented by Mr. L. Haseman.

AMOUNT OF ARSENIC PLACED IN CALYX CUPS AND LETHAL DOSAGE FOR APPLE WORM

By L. HASEMAN, *Columbia, Mo.*

ABSTRACT

The original purpose of this investigation was to determine what type of spray nozzle and what pressure places the greatest quantity of arsenic in the lower calyx cup of apple blossoms for the control of the codling moth, *Carpocapsa pomonella*. The spray tests are made immediately following the dropping of the petals by using usually three nozzles each with three pressures. To determine the calyx content of arsenic a counted number of the small apples are collected from each of the test trees and the lower calyx cups with their arsenical content are carefully removed for chemical analysis. In this way it has been possible to determine the average arsenical content of the calyx cup of each apple from trees treated with different pressures and nozzles. These experiments show that a high pressure and coarse nozzle is less effective than a lower pressure with a nozzle throwing a finer mist. They also show that where the average calyx content of arsenic is the highest the percentage of calyx worms in picked apples is not always the lowest.

After determining the average quantity of arsenic placed in the calyx cups under good orchard management, the investigation was enlarged in order to determine whether or not this quantity of arsenic is sufficient to poison apple worms attempting to enter at the calyx end of the fruit. This called for careful laboratory tests to determine the lethal dosage for apple worms. Doses of powdered arsenate of lead varying from one millionth to five ten thousandths of a gram were fed to apple worms of varying stages of development. To administer these small doses one or more drops of distilled water with the dose in suspension were placed on bits of apple

which the worms consumed. These experiments show that for third instar apple worms and older ones, the lethal dosage is approximately five ten thousandths (.0005) of a gram of powdered arsenate of lead. This is practically the same as the average calyx cup content (.000521 grams) as shown from numerous orchard spray tests. It seems certain therefore that in good orchard spraying the lower calyx cup of each blossom hit squarely with the "Calyx Spray" will receive sufficient arsenic to poison the small apple worms which may attempt to enter the fruit at that point.

The writer began this study in 1909 under the direction of the late Professor Slingerland and continued it in 1910 under Professor Herrick. The original purpose was to determine what pressure and what type of nozzle placed the greatest amount of arsenical down in the calyx cups as protection against the later entrance of calyx worms. The first spray tests were made in the Farm Engineering Laboratory, Cornell University, where Professor Riley prepared special equipment to maintain absolutely constant pressures with each nozzle. The chemical analyses were made by Professor Cavenaugh of the Agricultural Chemistry Department.

On returning to the University of Missouri, the writer went into the orchard with the experiment in actual spray tests. As new or improved nozzles were brought out they were included in the tests. Except for a few years when frosts or funds prevented, the experiments have been repeated in the experiment station orchard at Columbia, Missouri each year since 1910. As the work progressed the original purpose of the study was expanded to include an accurate determination of the actual quantity of arsenic placed in each cup by each nozzle, and pressure used. Then the question arose, is this quantity sufficient to actually kill the codling moth larvae of different ages or sizes. This called for a laboratory test to determine the lethal dosage for apple worms. All chemical analyses have been made by members of the Agricultural Chemistry Department.

Plan of Procedure

Each year a block of apple trees including one or some seasons two standard Missouri varieties, Jonathan, Ben Davis and Missouri Pippin, has been set aside for these tests. These trees receive the first spring or clusterbud spray just the same as the rest of the orchard. When conditions are right for the calyx spray the experimental trees are sprayed by an experienced orchard man, being given a thorough treatment with the standard spray solution including one pound dry arsenate of lead and one and one-half gallons liquid lime sulfur in fifty gallons of water. A power sprayer maintaining reasonably constant pressures

is used. To avoid variation in strength of solution all tests each year are made from the same tank of spray solution kept agitated throughout the test. The later summer applications like the first are given to the entire orchard alike.

Usually three pressures, 75 pounds, 150 pounds, and 250 pounds have been used. The small Vermorell, disc, and Bordeaux nozzles and the spray gun have all been tested out.

In a few days after the calyx spray is applied a counted number of apples are collected from each of the experimental trees. Two hundred and fifty and five hundred apples are used for the tests to determine the quantity of arsenic in the calyx cup. For the calyx cup tests, the tip of each apple is pealed, and the sepals, exposed part of pistal and stamen bars removed and the calyx cup with a small part of the flesh at the tip of the young apple is then removed for later chemical tests. These are dried and later tested for total arsenical content of sample.

In the fall the crop from each tree is gathered and each apple carefully examined for every type of injury by insect or fungus disease, a separate record being kept of all calyx end worms.

Experimental Results

It is not the intention of the writer to insert here detailed tables with results of all the years tests but merely to include figures on the 1920 experiment which is one of the completest.

Table No. I.

Pressure	Nozzle	No. calyx cups	Weight of Sample	Percent arsenous Oxide	Total AS_2O_3	Quantity per Calyx	% Apples with calyx worms
250 lbs.	gun	450	4.7249	1.128	.05329	.0001184	3.63
" "	bordeaux	400	5.4703	1.353	.07401	.0001850	5.62
" "	disk	410	5.1671	1.006	.05198	.0001267	6.00
150 "	gun	450	5.4500	1.627	.08867	.0001970	1.92
" "	bordeaux	450	5.6576	1.013	.04718	.0001048	3.01
" "	disk	450	4.8520	1.249	.06060	.0001346	2.59
100 "	gun	250	2.8373	0.510	.01447	.0000578	0.25
" "	bordeaux	250	2.3250	1.433	.03331	.0001332	4.55
" "	disk	250	2.6520	2.660	.07054	.0002805	4.20

In this experiment the greatest quantity of arsenic per calyx cup wa deposited with the lower pressure, 100 pounds and the disc nozzles The spray gun with 150 pounds pressure and Bordeaux nozzle with 250. pounds pressure gave almost equal quantities but much less than the disc and 100 pounds pressure. The poorest results were secured with the spray gun at 100 pounds pressure. Except for the four above mentioned cases, the quantity of arsenic is practically the same in all the tests. A

glance at the records on calyx worms taken at picking time shows best results with 150 pounds pressure. The variety used throughout this test was Jonathan.

Determining the Lethal Dosage of Arsenic for Apple Worms

It is a recognized fact that with careful systematic spraying one can produce a crop with a very small percent of wormy fruits when checks show a very high percent of worms. The calyx spray properly applied may keep a crop of apples almost free from calyx-end-worms. This may properly be interpreted as meaning that the arsenic placed in the calyx cups is sufficient to poison worms attempting to enter the fruit at that point. To determine experimentally whether or not this is true, careful laboratory feeding experiments were made during the past fall. The dosage fed to the worms under experiments was carefully determined by first preparing in distilled water, solutions containing varying quantities of arsenate of lead. The solution used contained one gram dry arsenate of lead to 100, 400, 1600, 6250, 10,000, 15,000 and 1,000,000 cc. of water. Then after the solution to be used was thoroughly shaken to distribute the arsenate of lead evenly, one, or in some cases, two drops of the solution were dropped into a small cavity cut in a bit of apple. After slightly drying the treated bit of apple was then turned upside down over the worm in a small glass jar. In the majority of cases the worms at once set to work eating out the treated apple pulp, often leaving only a thin surface layer that usually dried so as to be unpalatable. In this way those worms which fed properly consumed the bulk of the treated pulp. By watching the worms, however, it was noted that some of the larger ones, that were not kept without food for a day or so just before making the tests, would cut off and discard bits of the surface treated pulp thus failing to consume the full dosage. The smaller hungry worms, however usually fed properly. This tendency on the part of some worms to discard bits of the treated pulp made it difficult to determine, just what part if not all, of the dosage was consumed in such cases. Repeated tests with careful examination to see just what was consumed are necessary in order to draw conclusions from feeding tests on the apple worms.

In these feeding tests no worms under the second or third instar were used. All specimens used were taken from infested apples. Careful breeding experiments carried out at Ithaca, New York in 1909 showed that usually the larvae are in the third instar before they eat down into the pulp. These experiments therefore deal with worms varying in age

from third instar larvae to full fed larvae. Later tests will be made to determine the lethal dosage for the young stage worms such as in nature are normally found feeding in the calyx end of the fruit. However, it may be safely assumed that a dosage that kills the worms beyond the second instar will certainly kill first instar larvae.

The following table shows the results secured by feeding larvae of varying sizes different quantities of arsenate of lead in determining the lethal dosage for larvae varying in age from the third instar to nearly mature larvae. In this work six different dosages were used varying from three and one-third millionths to five ten thousandths grams arsenate of lead.

TABLE NO. II

Size of worms	No. worms	Dosage	No. days observed	Remarks
Very small	2	.00000333	2	Almost dead
One-fourth grown	1	.00000333	5	Almost dead
Very small	1	.00000333	4	Alive
Small	1	.000005	3	Dead
One-half grown	1	.000005	2	Dead
One-fourth grown	1	.000005	2	Nearly dead
One-half grown	1	.000005	2	Alive
½-¾ grown	3	.000008	?	Alive
¼-½ grown	1	.0000312	4	Dose repeated. Dead
¼-½ grown	3	.0000312	6	Dose repeated. Dead.
One-fourth grown	1	.000125	4	Dead
One-fourth grown	3	.000125	4	Alive
⅓ to nearly grown	4	.000125	1	Alive
2 mm. long	1	.0005	2	Dead
½ grown	1	.0005	2	Dead
½-⅞ grown	2	.0005	2	Sluggish-had eaten little.
½-¾ grown	1	.0005	1	Dead
Nearly mature	1	.0005	2	Alive-fed little.

This shows that for the smaller larvae a dosage of only three and one-third millionths grams arsenate of lead may kill but that some of the nearly mature worms which fed but little were not killed with a dosage of five ten thousandths gram. However, where feeding was heavy this dosage killed all worms and may safely be considered as a killing dosage for all stages from the third instar to practically mature worms.

COMPARISON OF LETHAL DOSAGE AND CALYX CONTENT

If the lethal dosage for the older larvae is five ten thousandths (.0005) grams arsenate of lead then this is most certainly more than sufficient for the caterpillars of the first two or three instars which are the size of caterpillars which feed in the calyx cups. A comparison of the lethal dosage with the calyx content will show whether or not our ordinary spraying method places sufficient poison in the calyx cups to kill the young worms.

The average of the nine above tests for calyx contents is .0001487

grams AS_2O_3. To reduce this to arsenate of lead we must multiply by 3.509[1] which gives .000521 grams arsenate of lead to the calyx cup. It is evident therefore that in our regular spray work we place on an average sufficient arsenate of lead in each calyx cup to poison even a full grown larva of the codling moth should it eat all of it. Such being the case then each calyx cup properly hit with the spray will receive enough poison to prevent the entrance of first, second or even third instar larvae.

Conclusions

These experiments show that:

1. In thorough orchard spraying a killing dosage of arsenate of lead for young apple worms is placed in the calyx cup.
2. A coarse spray under high pressure is not essential.
3. The spray gun with high pressure is effective.
4. The plats showing the greatest average calyx content had low tho not the very lowest calyx infestation at picking time.

President J. G. Sanders: The next paper is by Mr. O. I. Snapp.

RECENT DEVELOPMENTS IN PLUM CURCULIO INVESTIGATIONS IN GEORGIA

Oliver I. Snapp, *Entomologist, U. S. Bureau of Entomology, Fort Valley, Georgia*

Abstract

The establishment of the occurrence in the latitude of Central Georgia of two generations annually of the plum curculio, *Conotrachelus nenuphar*, and that a large percentage of the larvae injuring the best late varieties of peaches are larvae of the second generation were the most important truths revealed as a result of extensive investigations started in 1921. They followed the most severe outbreak of the plum curculio that has ever occurred in the South, when Georgia peach growers lost several million dollars from curculio damage. A third generation was carried through in the insectary in 1922. Picking up and destroying the small peaches that fell several weeks after the pollination season assisted greatly in correcting Georgia's abnormal curculio conditions, and is a wise supplementary control measure in latitudes where there are two generations of the insect. In one orchard a net saving of $5.25 per acre resulted from the operation. Discing to break up the pupal cells in the soil and burning over hibernating quarters during the winter months are other supplementary control measures that were successfully utilized. The investigations show that the ideal spraying or dusting schedule for the control of the plum curculio on peach in latitudes where there are two generations, consists of four treatments of arsenate of lead as follows: (1) Immediately after the petals fall; (2) When the fruit

[1]One pound arsenous oxide (AS_2O_3) will make 3.509 or 4.545 pounds of arsenate of lead depending upon process. Not knowing the formula of brand used the writer has used the smaller figure 3.509.

is exposed from the calyx; (3) two weeks after the second; and (4) four weeks before each variety is due to ripen. Four applications of lead is too much as an annual treatment for peach trees in the South. The four application schedule should be used when the curculio infestation is heavy, otherwise the lead in the third application should be omitted.

The severe outbreak of the plum curculio in the peach belt of Georgia during the season of 1920, which resulted in a loss of over two million dollars to the peach growers of that district, brought about the establishment of the Peach Pest Laboratory at Fort Valley, Georgia, and the inauguration of extensive investigations dealing with the life history and control of the insect. During the two years that this work has been under way some very important discoveries have been made in the life history of the pest, and a great amount of valuable data has been obtained on control measures. In order to make this paper as brief as possible it is my intention to develop only the most important results of this work, and to touch on the data that will be of most value to those working with the problem in other states.

The most important truth revealed as a result of these studies was the establishment as a scientific fact that in the latitude of Central Georgia there occurs annually two generations of the plum curculio, and that a high precentage of the larvae that renders the best late varieties of peaches unmerchantable in Georgia are larvae of the second generation. Furthermore, during the past season, I was successful in carrying through three generations, under normal conditions, at Fort Valley. The first adult of the third generation left the soil on October 7, the larva having left the fruit and entered the soil on September 11. Cool weather had set in before any of the third generation adults emerged, and a few days after their appearance from the soil they went into hibernation without the deposition of any eggs, or without showing any signs of copulation. Of course the third generation of the plum curculio is of very little importance in Georgia since the peach season is normally over there by August 1. The third generation was reared in the insectary in peach; late peaches being supplied, a few of which are grown by several growers in Central Georgia. These important discoveries, during the last two years, in the life history of an insect that has been referred to for nearly two centuries, and about which perhaps more has been written than any other American insect, are good illustrations of the probability that we still have a good many things to find out about even our best known insects. These interesting discoveries also indicate that the plum curculio should again be thoroughly studied throughout its range

of distribution, paying particular attention to the possible number of generations.

In planning the curculio suppression campaign, which has been so successful in Georgia for the two seasons following the heaviest curculio infestation that has perhaps ever occurred in this country, an effort was made to especially concentrate control measures on the first generation, because by so doing the size of the second generation, which is responsible for most of the "wormy" fruit of the desirable and profitable late commercial varieties in Georgia, would be correspondingly reduced. A great deal of stress was placed on the importance of picking up and destroying the small peaches that drop to the ground a few weeks after the pollination season. I am strongly of the opinion that this control measure did as much, if not more, to correct the abnormal curculio conditions in Georgia than anything that was done. This supplementary control measure was met with some opposition when it was first advocated two years ago, but the results accomplished from its utilization and the economy of the operation soon attracted the attention of the growers all over the peach belt and during the past season, when one of Central Georgia's best peach crops was produced, this control measure was enforced by at least ninety percent of the commercial growers.

Peach drop experiments conducted in Georgia show that an average of over fifty percent of the peaches that drop before May 5 are infested with curculio larvae. Repeated observations made during the past two seasons show that a majority of the peaches stung by the curculio shortly after the calyx is pushed off, fall to the ground. This is a result of the fruit being weakened by the work of the curculio, causing it to fall with other weakened fruit in Nature's system of thinning during the April drop. Consequently, the frequent destruction of the early drops prevents the development of countless numbers of the adults of the first generation, and this has a direct bearing on the reduction of the destructive second brood of larvae.

In order that some idea may be had as to the curculio infestation in peach drops in the South, and what could be accomplished by the picking up and destruction of this fruit, I will cite a part of the results of the peach drop experimental work conducted in Georgia during the 1921 and 1922 seasons. About four weeks after the falling of the petals in 1921 two and one-half bushels of drops were collected in an orchard near Fort Valley, and placed in shallow boxes fitted with wire mesh bottoms, under which were cloth trays for receiving the larvae. Each morning the larvae were counted and removed from the trays. At the end of

five weeks, when all larvae had reached maturity and left the fruit, our records showed that the two and one-half bushels of peach drops yielded 12,093 matured larvae. The adults that would have ultimately resulted from the infested drops in this orchard could have easily caused a heavy infestation in a 100,000 tree orchard by harvest time if uncontrolled.

This supplementary control measure of gathering up the drops was continued in this orchard each week during the season until the smaller fruits had stopped falling, and the spray schedule as recommended was carried through to the letter. The orchard was also disced several times for the destruction of first generation pupae about June 1. During the past season, 1922, two and one-half bushels of drops were again collected at approximately the same time as those in 1921, and placed in wire bottom boxes. After all larvae had left the fruit our records showed that the two and one-half bushels of drops this year gave only 2,752 larvae. The control measures enforced during the 1921 season were unquestionably largely responsible for this big reduction in the infestation.

The very small peaches that fall first are the ones that contain most of the larvae, and the percentage of infested drops decreases as the larger fruits fall. Under normal conditions it would not be economical for Southern peach growers to make more than three collections of drops, making the first soon after the shucks shed, and the other two at intervals of five or six days. Results of some recent experimental work along this line, where the drops were collected from a large orchard regularly every few days and placed in separate wire trays, showed that the first collection of drops, which was made shortly after the shucks had been pushed off, contained 62.6 percent of the larvae collected in dropped peaches in this orchard during the entire season. The second collection made five days later contained 16.7 percent of the larvae, the third collection 9 percent, the fourth 2 percent, and so on. Over one-half of the larvae were contained in the first fruit collected, and the first three collections gave over 88 percent. These figures substantiate the results of former experiments in that the bulk of the infestation in drops will be found in the smallest peaches that fall first.

The cost of this operation is surprisingly low. Much of the early opposition to this control measure was based on the fear that the expense would be too heavy. Actual figures obtained on the cost of picking up drops in both commercial and experimental orchards average two and one-tenth cents per tree for the three collections. In one

orchard five collections were made at a cost of two and nine-tenths cents per tree.

Some interesting figures were obtained from picking up drops in a Georgia Belle orchard containing 1394 trees. The orchard was divided equally into two parts, and care exercised in the division to avoid subjecting one side to a greater area of possible curculio hibernating quarters than the other. The drops were collected regularly every five or six days from one part, and on the other part they were allowed to remain on the ground under the trees throughout the season. Both parts were otherwise treated exactly alike. They received the spray applications consisting of the same materials on the same days, and the cultivation in each section was always done on the same day. At harvest the fruit from a number of trees in the center of each block was cut open to obtain the data on the curculio infestation. The results showed that there was one and one-tenth percent less wormy fruit in the part of this orchard from which drops had been regularly picked up and destroyed. This operation saved $74.25 worth of fruit from each thousand trees in this orchard. After deducting the cost of gathering the drops during the season there was a net saving of $52.85 per thousand trees. This would figure a net saving of around $5.25 per acre. The chief benefit, however, from the operation is that of preventing the development of myriads of adults, and thereby reducing the infestation of subsequent peach crops, which cannot be computed in definite dollars and cents.

We have found that the best way to dispose of peach drops is to bury them in a trench, covering them with a layer of quick lime and at least twelve inches of soil. Some growers burn their drops, but this is not very satisfactory on account of the water content of the fruit. Others have disposed of drops by throwing them into a pond or river. I doubt the expediency of this method of disposition, as we find that the curculio larva and pupa are able to keep alive on top of water for a considerable length of time.

When it became known that peaches were damaged in the South by more than one generation of the curculio, we gave a great deal of attention to a revision of the spraying and dusting schedules, so that the second brood of larvae, which is by far the most destructive one in the South, may be successfully controlled. A very important discovery in this connection has been made. We found that the adults leave their hibernating quarters and are on the trees in numbers by the time they are in full bloom. The adult curculio generally does a considerable amount of feeding before copulation or before egg deposition. They feed

greedily as soon as they leave their hibernating quarters, and this feeding usually takes place on the green succulent calyx which envelops the peach during the blooming period and for a week or ten days thereafter. Of course the plum curculio prefers the peach fruit to the calyx as food, but when the first meal is taken the peach is not exposed, it being entirely enveloped in the calyx. Observations on this habit of the plum curculio were first made in Mississippi during the 1920 peach season.

We have found that an application of lead arsenate immediately after the falling of the petals, so as to poison the calyces, kills off many adults as they appear from hibernation and before they have a chance to feed or deposit eggs in the small peaches. This early treatment of lead arsenate produces a marked reduction in the infestation in drops, which directly affects the size of the second brood of larvae by cutting down the number of first generation adults. A higher percentage of the set fruit reaches maturity when the early application is used, as the number of fruits that drop before maturity is greatly influenced by the number of peaches "stung" as soon as the shuck is off. Furthermore, the overwintering adults in some cases deposit eggs throughout the season, and this early application also lessens damage from these beetles. Spraying and dusting experiments conducted by the U. S. Department of Agriculture in cooperation with the Georgia State Board of Entomology during the past season show the curculio infestation in peach drops to be 25.7 percent where the first lead arsenate treatment was not made until the shucks were shedding, whereas the infestation in the drops on the plat that received the first treatment immediately after the falling of the petals was only 11.8 percent. The infestation of the drops from the check plat in this orchard was 43.1 percent.

Results from spraying and dusting experiments for several years have shown that an application of arsenate of lead about twenty-eight days before each variety is due to ripen, is the most important one for the second brood of larvae in latitudes where two generations of the plum curculio occur. Egg deposition by the plum curculio in the peach takes place during two distinct periods in the development of the fruit; namely, between the shedding of the shucks and the beginning of the stone hardening period, and during the ripening and swelling period. There are practically no eggs deposited while the stone of the peach is hardening, which usually starts about four weeks after the shucks fall and lasts until about four weeks before the fruit is ready to be harvested. Since some overwintering adults deposit eggs over a long period of time,

and since an application of lead arsenate applied before the stone hardening period will not protect it from the curculio during the ripening period, peach growers in latitudes where only one generation of the curculio occurs annually may also find a lead arsenate treatment four weeks before harvest of value. In Georgia last season 17 per cent of the peaches harvested from a large plat were "wormy" where the arsenate of lead treatment four weeks before harvest was omitted, whereas the infestation from a large plat where the lead arsenate final treatment was applied as the fruit entered the ripening period was only 1.8 percent. The check in this orchard gave 23 percent "wormy" peaches.

The ideal spraying or dusting schedule for the control of the plum curculio on peach in latitudes where there are two generations, consists of four treatments of arsenate of lead as follows: (1) immediately after the petals fall; (2) when the fruit is exposed from the calyx; (3) two weeks after the second; and (4) four weeks before each variety is due to ripen. This is the schedule that was recommended and so successfully used by the growers in Georgia during the past season, when one of the state's best peach crops was produced. The lead arsenate was used at the rate of four pounds of the powder to the 200 gallon tank. Four applications of lead arsenate at that strength is too much as an annual treatment for peach trees in the South. Some leaf margin burn resulted from the use of this schedule in a number of orchards in Georgia during the past season, and we expected it when the schedule was recommended. Every known method was being utilized to correct Georgia's abnormal curculio situation which was threatening the great peach industry in that state, and for that reason no hesitancy was made in recommending this schedule. No severe injury occurred from its use, however, in any orchard; and in any section of the South where the curculio infestation has been severe, or where it is expected to be bad this schedule mentioned cannot be improved upon and should be used. Its continued use year after year would perhaps eventually affect the productivity of the tree. Under normal curculio conditions in latitudes where two generations occur it would perhaps be better to omit the first or third application of the schedule mentioned, or make all four applications using three pounds of lead arsenate per 200 gallon tank instead of four pounds. These variations from the proven schedule, in order to reduce foliage burning, will be given special attention in the spraying and dusting experimental work in Georgia during the 1923 season.

A detailed account of other interesting facts brought out as a result of

these studies and investigations would make this paper too lengthy. I wish to mention, however, two other control measures that helped us to save the Georgia peach crop from the curculio. They are discing for pupae destruction, and burning over hibernating quarters during the winter months. Upon maturity of the plum curculio larva a cell is made in the soil where the pupal stage is passed. Some time is spent in preparing this cell, and usually the insect does not pass to the pupal stage for a week or more after it enters the soil as a larva. If these soil cells are broken, after the insect enters the pupal stage, the helpless pupa is soon killed by the pressure and heat of the soil. It had been found that these cells were nearly always made within the top two or three inches of soil. Consequently the use of an extension disc, which made possible the breaking up of the top soil under the spread of the branches where most of the pupation takes place, was strongly recommended during the latter part of May and the first two weeks in June. The orchards are usually worked a great deal anyway at this season of the year, and by the grower giving special attention to the discing under the trees many pupae were no doubt prevented from developing.

During the winter months all places near and adjoining peach orchards where the curculio might hibernate were burned over close to the ground. Fence rows and terrace rows were cleaned up, and rubbish piles and pruning heaps destroyed. Woodlands or wastelands adjoining peach orchards were burned over. We found that most of the hibernation in woodlands takes place within the first three hundred yards of a peach orchard, and growers were advised to go into wooded areas to that distance and brush back the rubbish with a pronged stick and light the windroll, allowing the fire to burn toward the orchard. In this way forest destruction was prevented by holding the fire in check. Jarring records showed a reduction of adult curculios in the Spring in orchards around which hibernating quarters had been burned over during the winter.

In connection with our life history studies at Fort Valley we jar a block of trees every other morning from the last of February until Fall. During the past season the control measures mentioned in this paper were enforced in the orchard used for this work, but were not fully carried out during the preceding season. The largest average catch of adult curculios in any one day from this orchard during the past season was 4.9 beetles per tree, whereas the catch on several days during the 1921 season reached 8.8 beetles per tree. There was almost a one hundred percent reduction in the curculio infestation in this

orchard during the past season, and the results here were fairly representative of those obtained in the majority of the commercial orchards in Central Georgia during the 1922 season.

PRESIDENT J. G. SANDERS: We will now listen to a paper by C. A. Weigel and C. F. Doucette.

CONTROL OF THE STRAWBERRY ROOTWORM IN COMMERCIAL ROSEHOUSES

By C. A. WEIGEL and C. F. DOUCETTE

ABSTRACT

The results of three years' study of the seasonal and life histories of the strawberry rootworm (*Paria canella* Fab.) under greenhouse conditions, are briefly reviewed as a basis in formulating an effective control program. Due to the long period of egg-laying the maximum numbers of beetle are present in June and July. The second brood emerges during September and October.

The practice of replacing plants and soil at intervals of several years aids materially in ridding a house of these insects. Various control measures which have been tested in different localities on a commercial scale are discussed. A series of fumigations with hydrocyanic-acid gas during the drying-off period, using 2 ounces of sodium cyanid per 1,000 cubic feet of space with an exposure lasting 2 hours, killed 97 per cent of the beetles. (Muslin curtains proved effective in confining the gas in separate sections of open-range houses). In one establishment as many as 60,000 beetles were collected in a week by persistent handpicking. Keeping the foliage dusted with a mixture of 10 or 15 pounds of lead arsenate and 90 or 85 pounds of superfine sulphur from February to November, protected the plants and killed many beetles. Scraping a layer of soil 2 inches deep from the beds after the plants were cut-back at the end of the drying-off period removed many beetles. The cut-back plants were then sprayed with arsenate of lead at the rate of 4 pounds to 50 gallons of water to protect the breaking eyes. Filming the surface of the water, which remains on the beds after syringing, with kerosene-nicotine oleate killed many beetles. A layer of wood ashes and tobacco dust on the beds operated to some extent against the larvae and pupae in the soil. Composting soil for several months or sterilizing before it is used in beds aids in keeping a greenhouse free from infestation.

The attention of entomologists has already been directed to the depredations of the strawberry rootworm on greenhouse roses by papers which were presented at two previous meetings of this society. The first article[1] dealt with the early reports received by the Bureau of Entomology regarding its injury to rose and presented the results of some preliminary control experiments. The next paper[2] described the

[1] C. A. Weigel and E. L. Chambers, Jour. Econ. Ent. April 1920, V. 13, no. 2, pp. 226-231.

[2] C. A. Weigel and C. F. Doucette, Jour. Econ. Ent. June 1922, V. 15, no. 3, pp. 204-209.

progress of the life history studies and experimental control measures. The following account is a summary of the results of the control measures which have been employed in commercial greenhouses and which proved effective.

It is thought desirable to review briefly the seasonal and life history of the insect under greenhouse conditions. The duration of the several stages are as follows: The egg stage varies from 7 to 15 days, the larva from 35 to 60 days, the pupa from 8 to 13 days, and the adult from about 70 to 100 days or more. One female lived for 364 days after emergence. During the winter months the adults remain in hiding in dead leaves or in the mulch and are seen only occasionally. About the middle of February they can be found more frequently feeding on the plants.

Egg laying commences about the first of March and continues through April and in some cases May and June. The larva and pupa stages are spent in the soil where the larvae feed on the roots of the plants. The first individuals of the new brood of adults begin to appear in May and because of the long period of egg-laying the number of beetles steadily increases, reaching its maximum in June and July. Soon after their emergence these adults deposit eggs and a second brood appears in September and October, the adults of which, however, do not lay eggs until the following spring. They feed voraciously for a time and then conceal themselves until the following February, occasionally coming out on warm clear days during the winter and feed to some extent on the green foliage.

Before discussing control measures carried out in individual establishments, mention should be made of the fact that it is a practice among rose growers to replace the plants and soil at intervals of several years. Without doubt this operation results in ridding a house of the insects provided it is done thoroughly and no beds are allowed to remain as sources of infestation. In the subsequent experiments to be discussed, the removal of plants and soil helped materially in reducing the severity of the infestation.

Investigation of the reported infestation at Alexandria, Va., in 1919 revealed the seriousness of the injury and the necessity for drastic control measures. Fumigation with hydrocyanic-acid gas using 2 ounces of sodium cyanid to each 1,000 cubic feet of space with an exposure to the gas lasting two hours, resulted in a 97 per cent mortality of all beetles above ground. The plants had been sprayed with arsenicals so that the surviving beetles found little green foliage to feed upon.

The next spring a light infestation was still evident but the replacing of all the plants during the summer ended the depredations and there has been no recurrence of the insects since that time.

A very heavy infestation was encountered in a large establishment of 250,000 plants at North Wales, Pennsylvania. The vast number of beetles present during the summer of 1919 was shown by the payroll for several school boys, who collected as many as 60,000 beetles in one week, at a cost of $150.00, or 25 cents per hundred beetles, and gathered several hundred thousand more during the subsequent period in which they were employed. While this practice destroyed many of the insects, nevertheless a large number escaped collection. A dust mixture containing 10 parts arsenate of lead, 40 parts air-slaked lime, and 50 parts sulphur was applied regularly throughout the summer of 1920. This was the only control measure followed that year, and in 1921 the injury done by the few beetles present was negligible. The reduction of this infestation was aided materially by the "tearing-out" during the winter of 1920–1921 of the more heavily infested sections in several houses, and incidentally by the collapse and subsequent rebuilding of the most severely infested house in February 1920.

Treatment of a heavy infestation at Roelofs, Pennsylvania, was started in 1920. The "tearing-out" of some sections helped only partially in the control since some heavily infested beds were allowed to remain and the beetles from them spread to the new plants. A dust mixture made up of arsenate of lead 10 parts, and sulphur 90 parts, was applied regularly during the summer and autumn of 1920 and the spring of 1921. The infested houses were fumigated once during the "drying-off" period in 1920 with hydrocyanic-acid gas at the rate of 2 ounces sodium cyanid per 1,000 cubic feet of space. During September and October 1920 the beds were watered heavily and the surface of the pools and puddles filmed with kerosene nicotine oleate,[1] using 1 pint of stock solution to 4 gallons of water. This was found to kill all beetles which came in contact with it while struggling in the water. Only a few scattered beetles could be found in several examinations in 1921. Dusting was continued throughout 1921 and also 1922 as a precautionary measure, and the infestation during July and August 1922 was negligible.

In a greenhouse at Oak Lane, Pennsylvania, 35,000 rose plants had suffered severe injury during 1919, 1920, and 1921. About two-thirds of the beds were replanted in the spring of 1921 but the infesta-

[1]Dr. Wm. Moore, Jour. Econ. Ent., June 1918, Vol. II, no. 3, pp. 341-342.

tion was very heavy on the older plants that fall. The only measure aimed directly at control was a practice of the workmen to collect and kill all beetles which would crawl up the wire stakes after every syringing of the plants. This was done regularly during September, October, and November in 1921, and on some days over a thousand beetles were collected and killed in an hour. The beds were kept immaculately clean and free from dead leaves and trash, and manure water was applied instead of mulching the beds. Only a few beetles could be found here and there during 1922.

A more intensive program than any of the preceding ones was carried on in an open-range of infested houses containing 40,000 plants at Doylestown, Pennsylvania. Sections of this place had been infested in 1919 and 1920, but during 1921 the whole range with the exception of about 8,000 new plants was overrun by the beetles. An average of 15 beetles to each plant in the badly infested houses is a conservative estimate of the numbers present during June and July.

The injury was so severe that it became impossible to produce salable flowers and the grower was obliged to stop his shipments to the markets. A series of fumigations with hydrocyanic-acid gas, as described in last year's paper, was employed during the month of July while the plants were being "dried-off." During these treatments the use of muslin curtains to separate sections of the open range proved satisfactory in confining the gas. The fumigations were quite successful for many dead beetles were found lying on the leaves and ground afterwards. After the plants were "cut-back" the surface layer of soil was scraped from the beds and in this removed material an average of three or four beetles per plant was found. The cut-back plants were sprayed with arsenate of lead at the rate of 4 pounds to 50 gallons of water to protect the swelling and breaking "eyes" as the florist terms the developing buds. As new foliage formed it was kept continually coated with a dust mixture containing 15 parts of calcium arsenate, 80 parts of sulphur, and 5 parts of powdered sugar. The dust applications were continued until the middle of November and were resumed in February 1922. About 1500 pounds of dust were used during the fall of 1921.

Starting in February 1922, wood ashes and tobacco dust were applied to the soil alternately at frequent intervals during the spring. Two carloads of each material were used. The absence of beetles at all times during 1922 has been in marked contrast with the large numbers present the preceding summer. Although a few beetles have been found occasionally, many searches lasting two or three hours have

succeeded in locating only five or six adults, and this condition prevailed throughout the year.

What do these commercial tests show? They have demonstrated that tearing-out the plants was of considerable importance in the reduction of all infestations; that fumigation with hydrocyanic-acid gas at the rate of 2 ounces of sodium cyanid per 1,000 cubic feet was used successfully during the drying-off period to kill the adults above the ground; that a persistent campaign of handpicking aided materially in getting rid of many beetles; that the regular use of an arsenical dust to keep the plants coated during the whole time when the adults were present was of prime importance in controlling them; that a dry mixture consisting of 10 or 15 pounds of either arsenate of lead or calcium arsenate, and 90 or 85 pounds of sulphur gave effective results; and that some of the other measures, such as scraping the soil surface, spraying the cut-back plants and applying tobacco dust and wood ashes on the soil to help combat the larvae and pupae, also have their places in an effective control program.

The following recommendations for control are based on the life history of the insect, and are applicable with the regular cultural practices. During the summer months the paramount consideration is to protect the plants from immediate as well as future injury. This may be accomplished by fumigation during the drying-off period to kill as many adults as possible, by scraping the surface soil from the bed when the plants are cut-back, and then spraying them with arsenate of lead or calcium arsenate using 4 pounds to 50 gallons of water to protect the swelling "eyes" from the further depredations of the beetles. During September, October, and November, eradication should be the florists' aim, because the beetles are still emerging and feed voraciously for some time. Every effort should therefore be directed toward ridding the houses of as many beetles as possible in order to prevent a recurrence of an infestation the following spring. During this period dusting must be very thorough and continuous in order to keep the foliage coated with the poison. Hydrocyanic-acid gas, however, cannot be used at this time at a killing strength without causing severe injury to the plants. Two or more treatments by filming the surface water of the bed with kerosene nicotine oleate may then be most effectively used to kill many of the adults. Beginning about the middle of February the plants must be kept coated with dust to poison any adults which may come out of hiding to resume feeding, and the soil in the beds should be kept covered with tobacco dust until "drying-off" time with occasional applications

of wood ashes at monthly intervals. These two materials will operate to some extent against the larvae and pupae in the soil and the tobacco dust will kill any newly hatched larvae which come in contact with it while crawling on or entering the soil.

To prevent an infestation from becoming established in a greenhouse, plants should not be retained in greenhouses longer than three years. In addition, cleanliness, involving the removal of dead leaves and trash, must be practiced incessantly, and soil which is used in the beds should either be sterilized or composted for several months before being brought into the houses.

From the preceding recommendations it is evident that no single practice or control measure will subdue this pest, and that successful control entails a program of several measures persistently followed and applied in such a manner that it will fit in with the normal cultural conditions under which roses are grown.

PRESIDENT J. G. SANDERS: Mr. George A. Dean will present the next paper.

ANOTHER STEP IN THE CONTROL OF THE HESSIAN FLY[1]

By GEORGE A. DEAN, *Entomologist, Kansas State Agricultural College*

ABSTRACT

The Hessian fly, *Phytophaga destructor* Say, can be controlled very effectively in Kansas by early, deep plowing of the stubble, by destruction of volunteer wheat, delayed sowing and cooperative work along these lines. Observations show that the fly lives over in relatively small, low, moist springy places, usually of less than an acre though in some cases they may comprise 40-80 acres. The destruction of the fly in all such areas by turning under the stubble, keeping them free from volunteer wheat and restricting planting till after the fly-free-date is recommended.

During the last twelve years in Kansas, it has been demonstrated that the Hessian fly can be controlled very effectively by the following important steps: (1) Early, deep plowing of the stubble; (2) The proper preparation of the seed bed; (3) Destruction of the volunteer wheat; (4) Delay in sowing until the fly-free-date; and (5) Cooperation. Although we have been successful in controlling serious outbreaks of the fly, our methods of control have been primarily to terminate the outbreak rather than to prevent reinfestations, and thus it would seem that an important step in the control of the fly had been overlooked or neglected,

[1]Contribution No. 85, from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 8 of the Agricultural Experiment Station.

because no definite conclusion had been reached as to the carry-over places or the source of the reinfestations. For a number of years it was thought that few Hessian flies remained throughout the wheat fields, and with favorable climatic conditions here they increased until there were sufficient numbers to cause serious damage or an outbreak which might extend over only two or three counties, or over the greater part of the entire wheat belt. However, in certain seasons, careful surveys and thorough examination of wheat plants failed to reveal any stage of the fly in the majority of the fields, and in fields where the fly was found it was usually in some isolated spot in the field, or some local area extending over a number of fields.

Observations and surveys extending over a period of twelve years have shown that the fly, during the years when there were no appreciable injuries, instead of living over in very limited numbers throughout the wheat fields, survived and bred in local areas that might be termed "reservoirs" or "carry-over areas." In general, these "reservoirs" consist of low, moist, springy places with a heavy soil. With the exception of the southeast portion of the state which has a considerable portion of low, swampy land, with a heavy soil and heavy rainfall, these infested areas usually consist of only an acre of two, although in several cases they may extend over an entire field of from 40 to 80 acres, and in a few instances they may consist of several square miles.

For instance, on the north side of Mill Creek in Wabaunsee County, there is an area about one mile wide and five miles long in which the Hessian fly has been found every year since 1911, and the farmers claim it had caused serious losses for several years previously. A control campaign was inaugurated on two farms in this district in 1913 with such good results that in 1914 the campaign was general over the entire area and the fly was brought under control.

However, the fly has been able to persist in this area and whenever wheat was sown early or volunteer wheat was allowed to grow, it became abundant. A survey of this area in November, 1921, failed to show any fly except in one field where a few acres had been planted early. This same area was visited again Sept. 29, 1922, and the Hessian fly eggs were so numerous on all volunteer wheat throughout the entire strip that it was necessary to destroy all the volunteer before planting.

About six miles west of McPherson there is a large area, locally known as "the basin," which is an old lake bed with very poor drainage. Our records show that fly has been found in this area practically every year since 1908. Again, southwest of Salina there is an area consisting of

from three to four square miles, which is very level, and poorly drained. Every year since 1911 this area has been inspected and always has revealed the fly. Also, two miles east of Haysville there is a field consisting of about 25 acres made up of low, sandy soil which retains the moisture much longer than the adjoining fields. This field was first visited by Messrs. Kelly and McColloch in 1913, and a careful examination showed that about 50 percent of all the plants were heavily infested. A small swale at the north end of the field had a still heavier infestation. Other fields in the vicinity were not infested. The infested field which was planted about Sept. 23rd, following wet weather, had been in wheat continuously since 1906 and was badly infested the previous year.

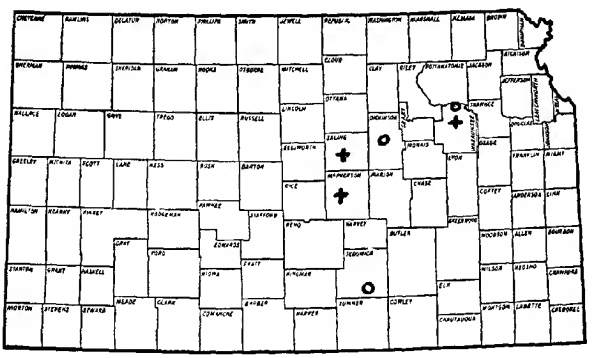


Fig. 3. Map of Kansas showing areas that have been infested continuously with Hessian fly for a period of from 10 to 12 years. + large areas. o small areas.

In order further to test this point, members of the Department of Entomology, in November, 1921, made a 60-mile circular trip east of Manhattan and examined every field of wheat for Hessian fly. The survey did not reveal a single fly, except in one field about 25 miles east of Manhattan. This field was so heavily infested that in some instances as many as 400 flaxseed were found in a single clump of wheat. The field consisting of low land, bordering on a small stream, had been

plowed early in the summer, but no attempt had been made to destroy the volunteer. The field was left for a spring crop. A survey around the field in September, 1922, showed the fly in large numbers and spreading to nearby fields of volunteer wheat.

In making Hessian fly surveys this fall, it was frequently noticed that the infestation was in small areas in the fields. Usually the field as a whole was free from fly, but here and there were spots consisting frequently of less than an acre where the fly was abundant. These spots were the lowest in the field and had many of the characteristics of the larger areas referred to above. In making a field survey last fall, emphasis was placed on these small areas and it was soon found that one could pick the infested places with a considerable degree of accuracy. On a trip from Manhattan to Salina, a distance of 74 miles, no fly was found except in the small, low spots in the fields. The same condition was found in a survey from Manhattan to Wamego, and from Manhattan to McFarland.

Careful surveys and observations during the past twelve years indicate that the fly is living over in these local areas or reservoirs, and from these areas is spreading or migrating into the main wheat fields whenever the soil conditions in them become similar to those of the local areas. If this is true, would it not be feasible or practicable to concentrate control methods on these local breeding places and thus prevent an outbreak? It would seem that it could be accomplished first by locating these places by careful surveys, and second by keeping them under careful observation. While one survey would probably serve for a period of several years, the observations of the areas after they are located should be made each year. In Kansas, the best machinery for making the surveys and keeping these reservoirs under observation would be the County Farm Agent, assisted or directed by the Extension Entomologist, and the Entomologist of the Experiment Station.

The fly in these local areas should be destroyed: (1) By turning under the stubble as early as the soil will permit of thorough deep plowing; (2) These places should then be kept clean of all volunteer wheat; (3) All wheat on these areas should be planted after the fly-free-date.

By practicing these methods over the greater portions of the principal wheat belt of Kansas, which can be done by utilizing the machinery we now have at our command, it seeems possible that outbreaks of the Hessian fly might be prevented.

PRESIDENT J. G. SANDERS: We will now listen to a paper by Mr. D. J. Caffrey.

SUMMARY OF RESEARCH ACTIVITIES ON THE EUROPEAN CORN BORER

By D. J. CAFFREY, *Arlington, Mass.*

(Withdrawn from publication)

PRESIDENT J. G. SANDERS: The next paper is by Mr. H. T. Fernald.

CHARTING LIFE HISTORIES

By H. T. FERNALD, *Amherst, Mass.*

(Withdrawn from publication)

PRESIDENT J. G. SANDERS: We will now hear a paper by Mr. J. N. Summers.

A JAPANESE TACHINID PARASITE OF THE ORIENTAL MOTH, CNIDOCAMPA FLAVESCENS

By JOHN N. SUMMERS, *Melrose Highlands, Mass.*

The Oriental moth, a native of Japan, was accidentally imported and became established in the Dorchester section of Boston some time prior to 1906, as it was discovered there in numbers early that year.

Very little has been heard of it since until last year when it was found to be quite abundant in some portions of the infested area. This year it was also quite abundant and a scout of neighboring sections showed that there had been considerable spread since the last survey was made.

Last summer while in Japan studying natural control of the gipsy moth, my attention was called by Mr. J. L. King of the Japanese beetle laboratory at Yokohama to a Tachinid parasite of the Oriental moth which appeared to be quite effective in keeping it in check. A number of the adult Tachinids were reared and on my return to this country were sent to Dr. Aldrich for determination. He reported that they were specimens of *Chaetexorista pavana* B. & B. and that there were specimens at the museum from Japan which had been bred from the same host.

This Tachinid passes the winter as a puparium inside of the host cocoon with the remains of the host larva more or less surrounding it. The adults began to issue this year about the middle of June and continued to do so for nearly a month, moths and parasites coming out at

about the same time. The flies emerge by pushing off the lid at one end of the cocoon, the lid whose separation from the cocoon allows the escape of the adult moth.

Judging from reports and my own observations, this Tachinid is quite an effective enemy of the Oriental moth and it would be well worth importing and establishing, particularly in view of the increase of its host the last two years.

At the close of this paper, the final business was transacted, which is given in the report of the business session.

THE RESISTANCE OF WHEAT TO THE HESSIAN FLY—A PROGRESS REPORT[1]

By J. W. McCOLLOCH, *Associate Entomologist*, and S. C. SALMON, *Professor of Farm Crops, Kansas Agricultural Experiment Station*

ABSTRACT

The study of the resistance of different varieties of wheat to the Hessian fly, *Phytophaga destructor* Say, has been under way for several years. The results discussed in the present paper show that resistance does occur in the field and that this resistance is fairly constant. Soft wheats, as a class, are more resistant than hard wheats. The cause of resistance has not been determined, but many factors have been eliminated. The evidence indicates that it is due to physiological causes and that silica is in some way associated with it.

In a previous paper,[2] the writers presented a preliminary report on the relation of small grains to Hessian fly (*Phytophaga destructor* Say) injury, in which it was pointed out that the fly is able to discriminate between wheat, rye, barley and oats in ovipositing, and that there is a marked difference in the infestation of these grains and in the different varieties of wheat. In other words, certain kinds of small grains and certain varieties of wheat were resistant to the Hessian fly. The investigations have been continued whenever sufficient fly has been present and a large

[1]Contribution from the Department of Entomology, No. 84, and from the Department of Agronomy, No. 142, cooperating. This paper embodies some of the results obtained in the prosecution of projects Nos. 8 and 67 of the Kansas Agricultural Experiment Station. The writers desire to express their appreciation of the assistance rendered by Mr. J. H. Parker, Plant Geneticist, in the selection and propagation of certain of the plants, and to Messrs. H. Yuasa, M. G. Stahl, and F. C. Lewis for carrying out certain phases of the work.

[2]McColloch, J. W., and Salmon, S. C. Relations of Kinds and Varieties of Grain to Hessian Fly Injury. In *Journ. Agri. Research* 12:519-527, 1918.

amount of additional data bearing on resistance has been obtained. While it will not be possible to discuss all these data in this paper, it is the purpose of the writers to present some of the more significant results. Two major lines of investigation have been followed: First, to determine the relative infestation of different varieties and strains of wheat, and second, to determine why certain ones are resistant, or, if not, why they escape injury in some cases where others are seriously affected.

Relative Infestation of Different Varieties of Wheat

The first line of investigation has been conducted to establish the fact that resistance does occur and that it is consistent under various conditions. Numerous plantings have been made in the field each year, and in the greenhouse in 1920-1921. Over two hundred varieties and strains of wheat have been under observation, but, by elimination, this number has been reduced to about thirty in order to facilitate the work. Oviposition and infestation records have been kept on all plantings, and the percentage of infestation in the fall, at harvest, and under greenhouse conditions, is summarized in Table 1, (page 295).

These field and greenhouse tests have established a number of important points. (1) There is practically no discrimination by the adult fly in ovipositing, since eggs are deposited in large numbers on all varieties. (2) There is a great difference in the subsequent infestation, and certain varieties exhibit marked resistance. (3) Since several varieties, such as Illini Chief, Dawson Golden Chaff, Beechwood Hybrid, Currell Selection and Dietz, have had very few plants infested in the fall, they may be classed as resistant. (4) Other varieties as Turkey, Kharkof, Ghirka, Zimmerman, and Marquis, have been very susceptible under all conditions. (5) A few varieties, as Kanred, Clark's Blackhull, and Fulcaster, have been erratic, being apparently resistant in one test and very susceptible in another. (6) The soft wheats, as a class, have been more resistant than the hard wheats, although one variety of soft wheat (Zimmerman) has been decidedly susceptible, while a variety of hard wheat (Red Winter 2132) has shown a marked tendency toward resistance. (7) The infestation at harvest in most cases has been in accord with that in the fall, although in the case of Beechwood Hybrid, Rudy, and Illini Chief, there is a tendency towards susceptibility. (8) Under abnormal conditions, such as greenhouse tests, the plants in general maintain their same relative position with regard to resistance.

The marked resistance of Illini Chief in the earlier experiments led

to an intensive study of this variety. The bulk crop as grown in the field was found to consist of a heterogenous mixture of types and a large series of pure lines were selected and propagated. Tests were conducted in the field at Manhattan and Hays, and in the greenhouse, with 54 of these pure lines, and, with the exception of two strains, all

TABLE I—SHOWING THE AVERAGE PERCENTAGE OF PLANTS INFESTED IN THE FALL, AT HARVEST, AND UNDER GREENHOUSE CONDITIONS

Variety	No.	Kind of wheat	Fall Infestation		Harvest Infestation		Greenhouse 2 tests
			No. tests	Aver. percent infestation	No. tests	Aver. percent infestation	Aver. percent infestation
Marquis		Spring	6	19.3			52.3
Kanred	2401	Hard Red Winter	9	25.0	4	38.7	40.8
Kharkof	382	" " "	8	32.5	3	44.0	33.2
Turkey	570	" " "	10	27.8	4	58.7	62.9
Red Winter	2101	" " "	9	24.0	3	40.0	57.5
" "	2132	" " "	10	8.2	4	24.7	24.9
Alberta	2105	" " "	9	19.4	3	41.3	
Defiance	2123	" " "	9	30.6	3	30.7	
Old Crimean	846	" " "	5	24.0	4	32.0	
Alberta	2048	" " "	4	13.0	3	30.7	36.8
Clark Blackhull	306	" " "	4	17.0	2	10.5	20.6
Beechwood hybrid	100	Soft Red Winter	10	2.2	4	23.	10.0
Miracle	106	" " "	9	4.0	2	6.5	9.3
Currell Prolific	90	" " "	9	7.1	2	2.5	5.8
Currell Selection	2406	" " "	10	4.4	4	19.0	
Harvest Queen	19	" " "	9	4.2	3	12.0	
Valley	70	" " "	8	4.2	2	14.0	
Rudy	77	" " "	10	6.0	4	23.2	0.0
Dietz	84	" " "	10	2.6	3	6.6	0.0
Illini Chief	223	" " "	9	1.3	4	17.5	5.5
Zimmerman	2084	" " "	8	32.2			42.0
Fulcaster	83	" " "	7	4.0			31.4
Mich. Bronze	2365	Soft White Winter	9	4.0	2	59.5	
Dawson Golden Chaff	78	" " "	10	1.8	4	3.0	14.9

showed the same resistance as the bulk crop. Two strains, No. 3278 and No. 3291, had a relatively high infestation at Hays and in the greenhouse, the latter strain being especially susceptible. A study of this strain shows that it differs from all the others, in that the grain is hard and vitreous in texture and resembles a hard winter wheat.

Cause of Resistance

Since the results of the field and greenhouse tests indicated that certain varieties of wheat were more resistant to the Hessian fly than others, the next step to be considered was the cause of resistance. During the past two years, much of the investigational work has been along this line. As there was no apparent discrimination by the adults in ovipositing, it was assumed that resistance was due to morphological or physiological characters of the plant. Preliminary experiments were, therefore, started to determine (1) the ability of the larvae on hatching to get down to their normal feeding place at the base of the plant, and, (2) their ability to rasp the stem and begin feeding. A large series of tests was made with selected varieties of the migration of the larvae and the results are summarized in Table II.

Table II—Showing the Percentage of Larvae that are able to Reach Their Normal Feeding Place on the Different Varieties

Variety	Number	Kind	No. of tests	Total No. larvae	No. of larvae getting down	Per cent of larvae getting down
Marquis		Spring	23	469	377	80.3
Kanred	2401	Hard Red Winter	35	1084	626	57.7
Turkey	2407	" " "	26	564	399	70.7
Red Winter	2101	" " "	43	1148	671	58.4
Red Winter	2132	" " "	31	649	422	65.0
Kharkof	382	" " "	24	383	305	79.6
Turkish Hybrid	196	" " "	27	478	282	59.0
Zimmerman	2084	Soft Red Winter	27	684	404	59.0
Currell Selection	2406	" " "	23	451	339	75.1
Beechwood Hybrid	100	" " "	1	34	11	32.3
Illini Chief	3278	" " "	5	372	159	42.7
" "	3291	" " "	18	714	445	62.3
" "	2591	" " "	54	1714	875	51.0
Illini Chief x Kanred	223x 2401		5	203	104	51.2
Illini Chief Sel. x Kanred Sel	223x 2401		14	1465	443	30.2
Dawson Golden Chaff	78	Soft White Winter	23	611	187	30.6

The results shown in this table may be summarized as follows: (1) There is a high mortality between the time of hatching and that of reaching the base of the plant on all varieties. (2) There is a marked difference in the percentage of larvae getting down on the different wheats, ranging from 30 percent for Dawson Golden Chaff and certain Illini Chief

and Kanred Hybrids to 80 percent for Marquis and Kharkof. (3) There is practically no difference in the ability of the larvae to get down between the soft wheats as a class and the hard wheats. (4) In all cases, enough larvae succeeded in getting down to seriously injure the plant should they develop.

This investigation of the migration of the larvae has failed to demonstrate any marked relation between resistance and morphological characters of the plant, although there is an apparent difference in the ability of the larvae to reach the base of the plant. Careful studies have been made of the structure of the leaf and the ligule, since these are closely associated with larval migration. With the exception of the height of the ligule there has been no correlation between gross morphological characters and resistance. In some of the resistant strains it was found that the ligule was slightly higher than in the susceptible strains, and, therefore, offered a greater barrier.

The next phase to be investigated was the ability of the larvae to develop after they had reached their normal feeding place. Experiments were conducted with a few resistant and susceptible varieties, and, while the number of tests was not as great as in the above experiment, they brought out several significant facts. Only 2.5 percent of the larvae developed on Dawson Golden Chaff; 13.4 percent on Illini Chief No. 2591, a resistant strain; and 62.6 percent on Illini Chief No. 3291, a susceptible strain. On the other hand, from 95 to 100 percent of the larvae developed on Kanred, Red Winter No. 2101 and No. 2132, Kharkof, and Zimmerman. It is of interest to note that Red Winter No. 2132, which has been consistently resistant under field conditions, has not been resistant when grown in cultural media. It was also found that in the case of the resistant varieties, when larval development did take place, it was usually high on the stem and not at the base of the plant. Growth of the larvae was slow on these varieties, and in some cases one-fourth grown larvae were still active and moving about instead of assuming the normal sedentary habit. Undeveloped larvae were generally found at the base where the leaf sheath has its origin.

The results of these observations indicated that resistance was due to physiological conditions and was located at the base of the plant. Experiments were, therefore, outlined for the purpose of studying the various physiological characters of the wheat plant, and especially of the outer cells of the stem. This line of investigation presents many difficulties and necessitates the development of special technique, consequently progress has been rather slow.

The first factor to attract attention was silica, since it occurs in large quantities in the ash of wheat straw. While the silica content of the different varieties of wheat is not known, it has been found in other plants that there is a marked difference, even between strains of the same variety. Silica has also been considered as the basis of resistance in the case of aphids on *Lithospermum arvense*, and of certain plant diseases.

A rather extensive series of experiments has been conducted by growing the different varieties of wheat in Pfeffer's culture solution to which varying amounts of sodium silicate are added. While this phase of the work has been underway for less than a year, and there is still much to do toward developing the technique, certain striking results have been obtained which indicate that silica has an important part in resistance. Several of the very susceptible varieties have shown marked resistance when grown in Pfeffer's solution containing a small amount of sodium silicate and the degree of resistance has varied with the amount of silica. The larvae reach the base of the plant, but as in the case of the resistant varieties discussed above, they do not develop. The data also indicate that different varieties of wheat respond differently to varying amounts of silica. The results have been of such significance that a thorough study of the utilization of silica by the different varieties of wheat is now under way.

SUMMARY

This paper, as the title indicates, is a progress report of the investigations of the resistance of wheat to the Hessian fly. The problem is far from being solved, but the results obtained are encouraging and are presented at this time in the hope that they will be of service to other workers in this field. The results of the experimental work discussed may be summarized as follows: (1) Evidence of resistance has been established in the field and this resistance is fairly constant. (2) The soft wheats as a class are more resistant than the hard wheats. (3) The cause of resistance has not been determined, but many factors have been eliminated. (4) Resistance in young plants is apparently located at the base of the plant. (5) Resistance in wheat cannot be explained by any selective action of the adults in ovipositing. (6) The fact that a sufficient number of larvae get down on all varieties to seriously injure the plant indicates that resistance is not due to gross morphological characters of the plant. (7) The evidence indicates that resistance is due to physiological causes and that silica is in some way associated with it.

FIVE YEARS OF HESSIAN FLY STUDIES IN OHIO

By T. H. PARKS, *Ohio State University*

ABSTRACT

Fall plant infestation counts have been made during five years in fields and plats of known dates of sowing. Actual safe sowing dates as they occurred for the same points in northern counties, varied widely during this time. This was apparently due to the difference in intensity of the brood and to meteorological influences. Permanent safe seeding dates are now established, but the entomologists, through surveys, locate the counties where the most intense fall emergence will occur. They, through the county extension service, devote their efforts toward guiding these counties past such an emergency.

Parasitism has been high in all flaxseeds passing the summer months above ground. Submerged flaxseeds gave rise to the most of the fall emergence during these years. Parasitism of submerged flaxseeds is limited largely to *Platygaster hiemalis* Forbes, which deposits its eggs in the fall in the eggs of the host. This parasite has been efficient in killing a high percent of the host larvae developing from eggs deposited during the first wave of emergence of adults, but does not control the host. It is absent in the fields during the visitation of the stragglers of the brood which, in Ohio, is the portion that perpetuates the insect in fields sown near the proper seeding dates.

In the fall of 1919 Ohio experienced the worst outbreak of hessian fly in its history. This outbreak was not unexpected since the entomologists had forecasted it by means of the wheat insect survey. Warnings against early seeding were announced but were not heeded by probably twenty percent of the farmers. Moreover the fly-free dates in northern counties were afterward found to be ten days later than expected. This resulted in widespread damage during the following summer. In 1920 general observation of the seeding dates was carried out by the farmers but the results were complicated by the summer hessian fly puparia dividing into three well defined groups in giving up their adult flies. The majority of the puparia gave up their adults as usual during the latter half of September. Another wave of emergence appeared almost simultaneously over all of the western half of Ohio from October 12th to 18th and during this period of time egg-laying took place on all wheat above ground. A third group, a much smaller one, remained in the summer puparia in the old stubble until the period of normal emergence of the spring brood. This peculiar behavior of the hessian fly in 1920 resulted in practically all wheat in northwestern Ohio becoming infested in October. The larvae grew rapidly throughout November and by December 10th were beginning to change to puparia. This transformation continued throughout December and January though many of the puparia were undersized. These gave up their flies during April and May and at the same time as the puparia resulting from the normal

September emergence and the fraction of the brood that held over in the old summer stubble. Thus in April the three groups arising from the previous summer's flaxseeds had again united. By July 1921 considerable loss from the hessian fly had occurred over all of northwestern Ohio. This was due almost entirely to the "late wave" or abnormal October emergence of 1920. At Columbus, where eggs of the "late wave" flies had been removed during October from several hundred plants, we watched the progress of damage during the fall and winter and compared it with the uninfested plants from which the eggs had been removed. In this way proof was secured that in central Ohio the most of the damage to the 1921 crop was done in the fall rather than in the spring and summer, which was evidently due to the high mortality of eggs deposited during cold weather in April. We also learned that the mid-October emergence had cost the Ohio State University approximately four bushels of wheat per acre on the experimental plats. This damage was much greater in northern counties where the brood of flies was heavier. Southern Ohio counties, by united effort, in 1920 eliminated the hessian fly as a menace in that part of the state. Northwestern counties, which had experienced two years of abnormal late emergence and egg-laying, had not yet completed the job. During the fall of 1921 and again in 1922 a large group of northwestern counties chose September 25th as their first safe seeding date. They were successful in preventing 99% of the wheat acreage being sown before that time. During both of these years the hessian fly emergence had been nearly normal and egg-laying was over in time to make this date safe. Climatic conditions were also favorable for the growth of late sowed wheat. The result has been that northwestern Ohio has at last won their victory and has the hessian fly well under control.

Commencing with the fall of 1920 the Ohio State University and State Experiment Station have each year conducted field emergence stations in two widely separated counties in northwestern Ohio. The manner of conducting these stations has been described in a previous publication.[1] This paper has to do mainly with the follow-up records of the percentages of plant infestation during November and their relation to the time of sowing. We have resorted to the gathering of much local data in these counties as a basis for future recommendations. These percentages of plant infestation were taken from experimental sowing plats and from a large number of fields scattered over these counties. The correct seeding dates of fields were in many cases recorded by the township crops committeeman. The results of the field inspections have been published

[1]Journal of Economic Entomology, Vol. 14, No. 1, 1921.

locally and have been used to good advantage in the fall seeding campaigns. At the present time the few early sowed fields that we can find scattered over these counties furnish the only evidence of what would have happened had the wheat been sown at the time formerly practiced. These fields stand as testimony that the job was well done and that the control that was brought about was due to cooperative effort of the farmers and not by natural agencies.

The hessian fly control in northern Ohio has been difficult because of the following reasons.:

1—Farmers had been used to seeding wheat during the middle of September.

2—The fly-free dates as they occurred varied considerably throughout four of the five years. They were as follows:

1918—Sept 18th in northern counties to Oct 4th at Ohio River
1919—Sept 28th " " " " " 3rd " " "
1920—Oct 10th " " " " " 6th " " "
1921—Sept 22nd " " " " " 4th " " "
1922—Sept 23rd " " " " " 2nd " " "

The record of field infestation as it occurred during the five years in the counties in northwestern Ohio including or adjacent to the site of the two emergence stations is shown in the tables. Where two or more fields of the same seeding date were examined the average infestation for all is given.

HESSIAN FLY FALL INFESTATION DETERMINED BY EXAMINATION OF APPROXIMATELY 100 PLANTS IN EACH FIELD

Erie and Sandusky Counties			Williams County.	
When Sowed	*Percent Infested*		*When Sowed*	*Percent Infested*
Sept 10	24%		Sept 3	12%
11	34%		10	1%
12	34%		17	0%
13	38%		20	0%
14	17%			
15	15%			
18	8%			
20	2%			
21	0%			
22	0%			
25	1%			
28	0%			
		1919		
Sept 22	58%		Sept 6	90-100%
23	63%		12	70-80%
24	47%		17	30-50%
25	38%		18	30-50%
26	41%		20	20-30%
27	6%		22	10-20%
29	1%		24	10%
30	0%		25	0%
		1920		
Sept 15	79%		Sept 15	52%
17	80%		16	41%
23	100%		17	47%
27	35%		18	30%
29	32%		19	36%

Oct	4	43%		20	43%
	5	65%		21	22%
	7	61%		23	20%
	11	7%		25	48%
				28	19%
				29	16%
				30	15%
			Oct	2	12%
				6	0%
			1921		
Sept	15	98%	Sept	8	68%
	24	13%		13	79%
	26	0%		15	90%
				16	65%
				17	59%
				19	47%
				20	13%
				21	6%
				22	3%
				23	0%
				26	0%
			1922		
Sept	15	76%	Sept	16	29%
	16	55%		20	11%
	17	42%		21	27%
	19	19%		22	2%
	20	12%		23	2%
	21	16%		25	0%
	22	0%			
	23	0%			
	25	4%			
	26	3%			
	27	3%			
	28	0%			
Oct	2	0%			

The previous narrative of developments throughout each season leads up to the question of whether or not our fly-free date variations as shown above are of sufficient importance to discredit established safe sowing dates for northern counties. We do not believe such to be the case. However, it seems likely that established dates in northern Ohio will be continually subject to modification which should be determined upon by the entomologists. The intensity of hessian fly infestation as determined through the annual wheat insect survey will indicate to us in what particular section of the state and what particular group of counties modifications of established dates should be made. In heavily infested counties it is quite likely that the stragglers of a heavy fall emergence of adults would be equal to or greater than the crest of a light emergence. We have taken care of this by setting the dates two to five days later for such counties than the established dates for the entire state. With the extension organization now furnished within the counties, including committees to decide upon such policies, we find no difficulty in modifying a previously used seeding date when local conditions are explained to these crops committees. Published daily records of hessian fly egg-laying determined at the site of the emergence stations help to impress those farmers previously indifferent to the scheme of cooperation.

Parasitism

Each year since 1918 we have observed parasitism increase rapidly during July and August among all hessian fly puparia located above ground. By September 1st it is usually very difficult to find unparasitized hessian fly in the puparia above ground. It seems that external feeding parasites are able to take care of almost all of these insects which do not become covered with soil after larval maturity in June.

The question is raised as to whether or not external feeding hessian fly parasites, which of necessity must attack the host above ground, will ever become the controlling factor in suppressing an outbreak. Under Ohio conditions the writer has found during September a large percent of the flaxseeds beneath the ground. In Kansas the larger number of flaxseeds are buried in the soil by September. Such observations would lead us to believe that burning stubble even though it could be done, would be harmful rather than beneficial. By this means one would destroy practically all of the flaxseeds which either contain parasites or hessian fly larvae which make possible rapid parasite development.

We have two species of Platygaster which are known to oviposit in the egg of hessian fly and emerge from the puparia. *Platygaster hiemalis* Forbes, the fall emerging species, is the most common in Ohio. These parasites are capable of taking care of hessian fly even though the host becomes subsequently buried and inaccessible to most of the external feeding species. However, our recent studies reveal that *Platygaster hiemalis*, which is known to emerge only in the fall, is present only during the early emergence wave of hessian fly. It was entirely absent from the fields during the mid-October emergence of 1920. At Sandusky, Ohio, in 1921, *Platygaster hiemalis* adults which had been emerging freely during September in the hessian fly cages, ceased emerging September 29th. Hessian fly emergence and egg-laying were quite heavy on September 30th, and continued in reduced numbers until October 17th. Four years analyses of hessian fly puparia show that this parasite is abundant in the puparia infesting early sowed wheat which we discourage but is usually absent or very scarce during the period of visitation of stragglers of the main brood of hessian fly adults appearing late in September. Since it is stragglers of this brood which are liable to perpetuate the species in most seasons, by late sowing we are unconsciously working against these egg-infesting parasites perhaps to even greater extent than their host.

TABLE OF HESSIAN FLY PARASITISM BY PLATYGASTER HIEMALIS FORBES
Miami County Experiment Farm (West Central)

Year	*Date Sown*	*Percent of plants infested with fly*	*Percent of fly parasitized*	*Average*
1920	Sept 15	90%	85%	
1921	15	37%	81%	85%
1922	15	54%	89%	
1919	Sept 22	100%	57%	
1920	22	80%	38%	
1921	22	4%	65%	61%
1922	22	27%	84%	
1920	Sept 29	37%	6%	
1921	Sept 29	0%		6%
1922	Sept 29	0%		
	Hamilton County Experiment Farm (Southwestern)			
1922	Sept 18	68%	67%	
1922	Sept 25	37%	21%	
	Bryan, Ohio (Northwestern)			
1921	Sept 15	90%	90%	
1921	Sept 17	59%	46%	
1921	Sept 19	47%	41%	
1921	Sept 21	6%	6%	
1921	Sept 23	0%		

With such an interpretation of parasite behavior, we are lead to believe that hessian fly control is at present largely in the hands of the farmer and his willingness to cooperate. This has been demonstrated to us and we must assume our responsibility in interpreting sufficiently in advance of the need for action that there will be such need and put it in the hands of the farmer. The present farm organizations within the county make the work of the entomologist easier and the responsibility greater.

A NEW APPLE BUD-MOTH IN PENNSYLVANIA

By S. W. FROST, *Pennsylvania State College*

ABSTRACT

A new apple pest (*Sparganothis idaeusalis* Walk.) is brought to the attention of Entomologists. The species has been found abundant during the past five years. Brief life history notes are given showing that it resembles the Eye spotted Bud-moth, very much in habits. Reference is made to related feeders on apple and other fruits.

During the past five summers the writer's attention has been drawn to a new injurious feeder of apple, *Sparganothis idaeusalis* Wlk. It has been known to science for a long time as a general feeder. Fernald (1882) records it as a feeder on Black Haw (*Viburnum prunifolium*) and Blood root (*Sanguinaria* sp.). Mr. August Busck, of the United States National Museum, has unpublished records of the following food-plants: Blackberry (*Rubus* sp.), Osage orange (*Maclura pomifer*) Golden rod

(*Solidago* sp.) and Aspen. The writer has found it feeding abundantly on apple and Blackberry and has referred briefly to this species in earlier papers.[1] Its abundance and preference for apple place it, beyond doubt, among the pests of apple. Having no common name, the writer suggests the Tufted Apple Bud-Moth, taking its name from the conspicuous tufted scales on the fore wings of the adult. This name has been submitted to the committee on nomenclature of the American Association of Economic Entomologists.

This genus contains other species known to attack various fruits. *Sparganothis flavedana* Clem.[2] has been taken by the writer as an occasional feeder on apple, *S. deulticostana* Walsh feeds on cherry while *S. reticulatana* Clem. feeds on pear. There are many other species which feed on forest and shade trees.

Life History

Sparganothis idaeusalis Wlk. resembles the common Bud-moth (*Tmetocera ocellana* Schiff.) in its habits and manner of feeding and it is impossible to distinguish the injuries of the two species. During some years it has been found even more abundant than *Tmetocera ocellana*. Brief life history notes have been taken during the past five summers which give a basis of comparison with the life history of the common Bud-moth.

Eggs

The eggs are apple green in color and laid in patches of a hundred or slightly more. They resemble the eggs of *Tmetocera ocellana* or more closely those of the Red-banded Leaf-roller, *Eulia velutinana* Wlk. but can be readily distinguished from either because of the milky white translucent envelope which surrounds the egg mass, This envelope is much thicker and more prominent than the covering of the egg masses of the species mentioned above.

Larvae

The full grown larva is olive or brownish in color with a chestnut brown head and cervical shield. The cervical shield is uniformly colored, but is often lighter along the anterior margin. Each body segment has four conspicuous silvery setal tubercles which distinguish it from *Tmetocera ocellana* Schiff. A better character, however, is the presence of an anal comb while *Tmetocera ocellana* has none.

[1]See reference cited to author's papers.

[2]All determinations of species discussed in this paper were made through the courtesy of Mr. August Busck, U. S. National Museum, Wash. D. C.

Adults

The adults are small; seldom more than 12 mm. long. They are inconspicuous in color, varying from gray to brown. The basal one-third of the forewing is lighter in color, usually gray; the outer portion of the wing is darker; usually brown, with a lighter colored area along the costal margin. The tips of the fore-wings are beautifully ribbed longitudinally and beset with two or three groups of tufted scales.

The moths are active and frequently seen flying in the orchards during May, June, August and September.

Seasonal Life History

The half-grown larvae hibernate within the dead leaves of the previous season. The larva usually curls the edge of the leaf, fastening it with an abundance of silken threads. These leaves fall to the ground where the larvae pass the winter. They differ remarkably in this respect from the hibernation of the common bud-moth.

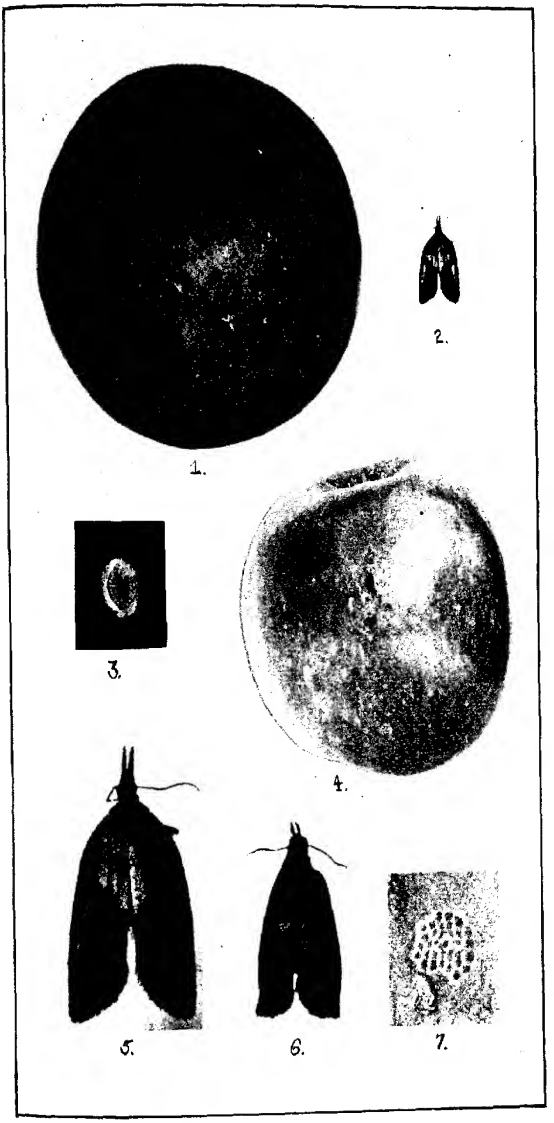
Early in the spring, about the time the buds begin to swell, these larvae leave their hibernating places and seek the opening buds. Here they feed on the developing leaves, often burrowing in the petioles or chewing the blossom.

They become mature towards the end of May or the first of June and transform to brown pupae. Within nine to eleven days the moths issue and a few days later the females lay eggs for a new generation. Some of the larvae hatching from these eggs become mature towards the first of August when they pupate and moths issue, laying eggs for a second generation. The majority of the first generation, as well as all of the second generation enter hibernation as partially grown larvae. It appears that there is normally only one complete generation during a year.

Life history notes taken over a period of five years are summarized in the following table. Intensive work was not begun on this species until 1922 and hence the records for previous years are not complete.

Abundance

This species has been found in numbers sufficient to warrant investigation and is by no means a chance feeder of apple. It has been found not during a single season but has been noticeable over a period of years and may have been abundant even before the writer first discovered it feeding on apple. As an index to its abundance the following counts were taken from a single unsprayed tree. 117 larvae were gathered



1, Bud moth injury on fruit; 2, Adult, *Sparganothis idaeusalis* Walk. natural size; 3, Eggs of *Sparganothis idaeusalis* Walk.; 4, Bud moth injury on fruit; 5, Adult, *Sparganothis idaeusalis* Walk. enlarged; 6, Adult, *Tmetocera ocellana* Schiff.; 7, Eggs of *Eulia velutinana* Walk.

SUMMARY OF THE LIFE HISTORY FOR A PERIOD OF FIVE YEARS

Overwintering larvae			New generation			Partial 2nd Generation
Year	Pupation	Adults emerged.	Eggs laid	Pupation	Adults emerged.	Eggs laid.
1918				Aug. 13	Sept. 14	
1919				July 24–Aug. 12		Aug. 20–Sept. 13
1920	May 31–June 1.	June 8–11			Aug. 24–Sept. 4.	
1921		May 18.			Aug. 1-9.	
1922	May 20–26.	June 1–7	June 7[1]	Aug. 1–7	Aug. 10–28.	Aug. 18–Sept. 5.[2]

[1]56 eggs laid by an individual female.
[2]399 eggs laid by six females.

from the lower branches of the tree; many were missed and some fell to the ground in collecting and were lost. On an examination at the laboratory the following species were discovered; 77 *Sparganothis idaeusalis* Walk., 24 *Eulia velutinana* Walk., 3 *Stenoma algidella* Walk., 1 *Ancylis nubeculana* Clem., 1 *Tmetocera ocellana* Schiff., and one undeterminable larva. It seems very evident, therefore, that this species is worthy of attention by fruit growers.

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OBSERVATIONS ON TABANIDAE (HORSEFLIES) IN LOUISIANA

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ABSTRACT

The observations here given in brief supplement the reports of Professor J. S. Hine on the Tabanidae or horseflies of Louisiana. Fourteen additional species have been taken. The larvae of ten species have been collected in the field and reared to the adult stage. During 1922 *Tabanus pumilus* was the worst stock pest of all tabanids in the vicinity of Baton Rouge. Two species of dipterous parasites have been reared from tabanid larvae.

During 1905 and 1906 Professor J. S. Hine made a study of the Tabanidae of Louisiana. The results of his work have been published in Circular No. 6 of the Louisiana State Crop Pest Commission (also published as Bulletin No. 5 of the Gulf Biologic Station) and in Bulletin No. 93 of the Louisiana Agricultural Experiment Station. As indicated

in these publications, it was considered advisable that the Tabanidae of Louisiana be studied, not only because of the direct damage they caused to livestock in the State on account of their blood sucking propensities, but also because of the suspicion that they were instrumental in the spread of anthrax or charbon, a dread disease of livestock. In 1920 the Tabanidae, because of their importance, were again made the subject of a project of the Louisiana Station and it is our purpose to here record briefly the progress of this project insofar as the observations made supplement the reports of Professor Hine.

Additional Species Collected in the State

Besides taking the majority of the forty species recorded by Hine as having been found in the State we have collected several others. These include the following, specimens of all of which have been identified by Dr. J. M. Aldrich of the United States National Museum:—*Diachlorus ferrugatus* Say, *Chrysops montanus* O. S., *Tabanus cerastes* O. S., *T. flavius* Macq., *T. giganteus* DeG., *T. lasiophthalmus* Meg., *T. longiusculus* Hine, *T. reinwardtii* Wd., *T. stygius* Say, *T. turbidus* Wd. Additional species, determined by Professor J. S. Hine, are:—*Chrysops separatus* Hine, *Tabanus fuscopunctatus* Macq., *T. imitans* Walker, and *T. aequalis* Hine.

Observations on Adults of Additional Species Collected

Two adult females of *Diachlorus ferrugatus* have been collected. One was taken at Baton Rouge (Apr. 25) and the other at Lutcher (July 2).

Two females of *Chrysops montanus* have been taken in woods at Magnolia (East Baton Rouge Parish) while flying about the collector's head. One was taken between 5:00 and 5:30 A. M. (May 16) and the other later in the day (May 15). A female adult of *Chrysops separatus* was noted feeding at the base of a cow's ear at Baton Rouge on April 7, 1922.

An adult male of *Tabanus lasiophthalmus* was found in a greenhouse at Baton Rouge on March 28, 1922.

A female of *Tabanus stygius* has been taken at New Orleans (Aug. 15) and another has been collected from a mule at Baton Rouge, (May 10). From this same host and in this same locality single females of *Tabanus cerastes* (May 16) and *Tabanus giganteus* (July 28) have also been secured, while females of *Tabanus longiusculus* have been observed feeding on horses near and in woods at Mound (June 29).

Tabanus flavus, a species whose body is of a pale yellowish tinged with green, resembles *Tabanus mexicanus* Macq. in appearance and the

two have been considered synonymous by some workers. Hine has recorded the latter species from Louisiana. Our observations indicate that the adults of *Tabanus flavus*, *T. uniformis*, and *T. turbidus* differ in their habits from the other horseflies that we have taken in that they are crepuscular. Adult females of *Tabanus flavus*, have been observed only during the afternoon of a cloudy day and at dusk. They have been collected from cows and horses; being taken at Magnolia (May 12), Mound (June 29), and Baton Rouge (Aug. 1). At Mound they were common on cows at 7:10 P. M., when ten individuals were counted while feeding on the side of one animal. Adults of *Tabanus aequalis* were common on horses in woods at Mound on June 29, 1922, between 7:10 and 7:55 P. M.

Females of *Tabanus turbidus* have also been observed only on the afternoon of a cloudy day and at dusk, though it is thought that we heard them in flight at about sunrise. Several specimens were taken at Magnolia (May 15) while circling about the collectors between 6:00 and 7:10 P. M. in woods. Although we were in the woods for some time before and after this period no adults were heard in flight at these times. At Mound a single individual was taken on the afternoon of a cloudy day (June 29) about a horse and a number of females were attracted to this animal at the edge of, and in, woods in this same locality between 7:10 and 7:55 P. M. (June 30).

Notes on Immature Stages

It is interesting to note that we have not as yet found larvae of those horseflies that, as adults, we have noted to be the more common species. Our search for larvae has been largely confined to those locations in the neighborhood of Baton Rouge where, as in water and in soil close to water, the majority of the immature stages taken by other workers have been found. This would perhaps indicate that more attention should be given to drier areas in searching for the immature stages.

Numerous larvae of the black horsefly, *Tabanus atratus* Fabr., the immature stages of which are well known, have been taken in wet soil and the larvae of seven other species have been taken from such material and reared to the adult stage in a well ventilated insectary. In all of our rearing work with these species we have kept the larvae in moist sand in small glass jars and fed them on earthworms. This method, while rather tedious, has proven satisfactory. The size of earthworms given as food has been varied with the size of the tabanid larva and it has been found that the amount of feeding that a larva will do depends upon its

size, its stage of development, and upon temperature conditions. Larvae feed but little during cool weather and usually stop feeding several days before pupating. Attempts made to rear larvae in nutrient agar, with the idea that they could be more easily kept under observation in this material, were unsuccessful.

Larvae of *Tabanus trimaculatus* Pal. Beauv. have been taken several times in the field. Some were found in soft mud at the edge of and beneath the water of a pool which is stagnant for the greater part of the year, while others were dug from moist soil beside a brook. Larvae taken in November and December pupated in April and the adults issued in from 8 to 15 days after pupae were formed.

Several larvae of *Tabanus imitans* Walk. have been taken from mud at the edge of a small pool. Taken on November 8, 1922, these larvae lived in breeding jars from the first of December until the first of March without feeding and without increasing in size. They then resumed feeding on earthworms and grew rapidly until the first part of April, when they again stopped feeding and became inactive. They remained in this condition until June, when they pupated, and the adults issued 12 or 13 days later.

A single larva of *Tabanus wiedemanni*, O. S., was taken on March 11, 1922, from mud under about ten inches of water in a swampy meadow. It pupated on April 30 and 13 days later the adult appeared. One larva of *Tabanus reinwardtii* and one of *T. fuscopunctatus* have also been collected in the field. The larva of the first named species was found in sand beside a slow flowing brook and that of the second species in the mud at the bottom of a brook. Both pupated in May; the adult of *Tabanus reinwardtii* issuing on May 31 and that of *Tabanus fuscopunctatus* on June 11.

Only two Chrysops larvae have been taken. Both were found early in March in mud under about a foot of water and about two feet from the bank of a small brook. On April 11 the two larvae pupated and after a period of 6 days adults emerged. One was a female of *Chrysops callidus* O. S. and the other a male of *Chrysops flavidus* Wied.

Professor Hine has already recorded observations made in Louisiana which indicated that the immature stages of *Tabanus annulatus* Say occurred in rotten logs. We have taken many larvae and a number of pupae from well rotted logs. With the exception of a single specimen of *Tabanus fulvulus* Wied. no other species has been reared from larvae found in such material. Larvae found in rotten wood were kept in such material in the insectary and fed earthworms. The first pupa of

Tabanus annulatus was formed in confinement on April 11 and the pupal stage of the several individuals under observation average 15 days, adults issuing for the most part during the first few days of May. The larva of *Tabanus fulvulus* was taken late in January, pupated on April 19, and the male adult issued on May 4.

Notes on Adults

We have attempted to ascertain, by field observations, the time of year when the adults of various tabanids occur in the vicinity of Baton Rouge, realizing, however, that this information is not necessarily indicative of conditions in other localities, even in our own State. The following table gives data that we have obtained during 1922 for some of our most common species.

Seasonal Occurrence of Adult Tabanids in the Vicinity of Baton Rouge as Indicated by Collections Made During 1922

Species		Earliest date taken	Latest date taken	Period of greatest abundance
Chrysops	*callidus* O. S.	April 11	June 26	May
"	*flavidus* Wied.	April 27	Oct. 4	Summer months
"	*obsoletus* Wied.	May 16	Sept. 13	Summer months
"	*pikei* Whit.	April 11	June 26	May and June
"	*vittatus* Wied.	April 25	Sept. 13	June
Tabanus	*abdominalis* Fabr.	June 26	Oct. 12	September
"	*annulatus* Say	May 13	June 29	Never common
"	*atratus* Fabr.	April 25	Nov. 1	Never common
"	*benedictus* Whit.	June 26	Sept. 20	Never common
"	*costalis* Wied.	April 25	Sept. 13	April to September
"	*fulvulus* Wied.	May 7	May 16	
"	*fuscicostatus* Hine.	May 16	June 30	May and June
"	*lineola* Fabr.	April 25	Sept. 30	Summer months
"	*pumilus* Macq.	April 11	July 28	Last week in April and first week in May

During the spring of 1922 *Tabanus pumilus* was so abundant as to be regarded, as the worst stock pest of all tabanids in the vicinity of Baton Rouge, though it must be borne in mind that in other years or in other sections of the State this species might not rank as so important a pest. The female flies of *Tabanus pumilus* confine their attack, for the most part, to the head of the animal, especially the ears. As a result these parts often become swollen and bloody. In one instance, on a mule, the blood from a large number of bites was flowing down the face and dripping to the ground. The adults do not hesitate to attack man, in which case they also show a preference for the head, especially if a dark hat is worn.

Some writers have already pointed out that certain horseflies are sometimes attracted to moving objects, such as trains and automobiles. We have noted this fact in connection with certain species of Tabanus and Chrysops. Adults of *Tabanus pumilus* and *T. fuscicostatus* have been observed to circle about and alight on an automobile while it was being driven over roads through woods. In one instance adults of the

latter species entered a moving automobile, alighted inside the top, and remaining there, became so abundant as to almost cover it.

ENEMIES

Two species of dipterous parasites of horseflies have been obtained and determined by Dr. J. M. Aldrich. These are represented by one specimen of *Phasiops flava* Coq. (Family Dexiidae) and two specimens of *Anthrax lateralis* Say (Family Bombyliidae). Neither species appears to have been heretofore recorded as a parasite of tabanids. The adult of *Phasiops flava* issued from the remains of a larva of what was apparently *Tabanus trimaculatus*. This larva was taken in the field while still alive and the parasite later pupated within the skin of its host.

The adults of *Anthrax lateralis* came indirectly from larvae that belonged, without much doubt, to *Tabanus annulatus*. These two larvae pupated and from each pupa a bombyliid pupa later freed itself, the fly issuing soon afterwards.

A CONTROL FOR JAPANESE BEETLE LARVAE IN GOLF GREENS

By B. R. LEACH, *Entomologist, U. S. Department of Agriculture*
and J. W. THOMSON, *Investigator, Department of Agriculture, State of New Jersey*

ABSTRACT

The larvae of the Japanese beetle (*Popillia japonica* Newm.) has become a serious pest in golf greens. As many as 300 larvae are found per square yard of turf. Sodium cyanid in solution kills the larvae but completely kills the grass. Emulsified carbon disulfide, when properly applied, controlled the larvae with no injury to the turf, in fact the material is a decided stimulant to the grass, the action being somewhat similar to an application of sodium nitrate.

The larva of the Japanese beetle (*Popillia japonica* Newm.) has become a serious pest in golf greens. The rich soil and heavy turf of the greens attracts the beetles, and eggs are deposited in enormous numbers during June, July and August. Under these circumstances it is not unusual subsequently to find as many as 300 larvae to the square yard of turf. The larvae feed upon the grass roots and by late August or early September the turf begins to turn brown and the green is largely ruined from the standpoint of the game of golf. Unless the green is worked up and reseeded, it is overrun during the following spring by weeds and coarse grasses.

Considerable experimental work was done at the Japanese beetle laboratory by J. J. Davis[1] using a solution of sodium cyanide in water as a

[1]DAVIS, J. J. "Miscellaneous Soil Insecticides Tests" in "Soil Science," Vol. X, No. 1, July 1920, page 61.

control for the larvae in turf. A satisfactory kill was obtained by this method, and according to his published results, the injury to grass was negligible. The writers' subsequent experience with this material corroborates the results secured by Davis as far as grub kill is concerned but in our experience the material is decidedly toxic to the grasses of meadows and golf greens. It kills practically all of the fine grasses and clover in meadows, and completely burns the fine grasses used in golf greens.

In connection with the above experiments the writers carried on tests in 1921 using a plain mixture of carbon disulfide in water, the mixture being maintained by agitation in a tank and run out thru hose on to the turf. The grub kill by this method was not entirely satisfactory, but it was noted that no injury resulted to the grass; in fact the material was *decidedly stimulating in its action.*

Under these circumstances the work with cyanide was dropped and the experiments were confined to a thorough testing of carbon disulfide. It was soon found that a plain mixture of the material in water was unsatisfactory, due to the uneven dispersion of the carbon disulfide thruout the water even when agitated.

.The writers therefore began a study of carbon disulfide emulsions, using various solutions of soaps as emulsifying agents. It was found that a fairly stable emulsion could be made with soaps in general, but the best emulsion, from all standpoints was obtained by using resin-fish-oil soap as follows: add 12.5 grams resin-fish-oil soap to 87.5 cc. of water and heat until dissolved; allow solution to cool; place solution in flask or butter churn and add 250 cc. of carbon disulfide: agitate until the ingredients emulsify, this condition being obtained in a few minutes.[2] The emulsion proper is white in color, and the consistency of thick cream. When added to water it diffuses evenly and stays in suspension indefinitely.

Tests were made with this material using various concentrations and various amounts of liquid per square foot of turf treated. For instance, 500 cc. of emulsion was added to a 50 gallon barrel of water[3] and stirred in with a paddle. The solution was then flowed out into the turf by means of a hose and "Ross" watering nozzle, the liquid being applied to

[2]Before making large quantities of this emulsion it is advisable for the novice to experiment with the emulsification of small quantities of the ingredients in an Ehrlenmeyer flask in order to observe the phenomenon.

[3]This concentration is approximately one liquid ounce of carbon disulfide to 4 gallons of water.

an area of 100 square feet, or at the rate of ½ gallon per square foot. The grub mortality was 95% with this concentration.

A lower concentration of solution was not sufficiently effective. On the other hand the grass was not injured by an application of 1,000 cc. per barrel applied at the rate of 1 gallon per square foot. Some injury occurred when 1,500 and 2,000 cc. concentrations were employed. In a few days after treatment with the proper concentration, the grass assumes a vivid green similar to that secured by an application of sodium nitrate.

The liquid is best applied when the turf of the green is fairly dry, since the soil is then in a condition to absorb the liquid with the minimum of run-off. The turf should not be flooded with the liquid. It should be applied lightly and allowed to soak in, and the operation repeated until the stipulated amount of liquid has been applied. Heavy applications applied hurriedly will cause injury to the grass and result in an uneven grub kill due to run-off of the liquid.

In this connection the past season's work has demonstrated the fact that application of the solution to the turf by means of rubber hose, manipulated by workmen, is unsatisfactory, due to unevenness of application with consequent flooding and run-off, and the damage caused by the incessant walking on the wet turf.

Under these circumstances future experimental work will consist in devising a means of automatically applying the liquid to the green. A modified portable overhead irrigation apparatus seems to be the most feasible method.

BORDEAUX MIXTURE AS A CONTROL FOR LEAFHOPPERS

By F. A. FENTON and J. H. TRUNDY *Entomology Section, Iowa State College*

ABSTRACT

Tests conducted with home-made Bordeaux Mixture, 4–4–50 formula and also with three proprietary preparations of this compound, indicate that these spray materials are toxic to the nymphs of at least one common and injurious cicadellid, namely: *Empoasca mali* Le B. They also are apparently toxic to the nymphs of three other species of leafhoppers, namely: *Empoa rosae* Linn, *Erythroneura comes* Say, and *E. tricincta* Fitch. The young nymphs are more susceptible to the action of the Bordeaux than the older ones, while the adults, although they are repelled from plants sprayed with this preparation, are not affected when forced to feed from treated leaves. Bordeaux mixture should therefore be classed as a specific insecticide for certain species of leafhoppers.

In preliminary tests[1] it was shown that Bordeaux mixture is toxic to the nymphs of *Empoasca mali* Le B. The following account summarizes experiments that not only substantiate the above statement, but also indicate that it is poisonous to the young of three other common species of injurious leafhoppers, namely: *Erythroneura comes* Say, *E. tricincta* Fitch, and *Empoa rosae* Linn.

Three different combinations of self-prepared Bordeaux and three types of proprietary mixtures of this compound were used in these tests. As shown in Table I, the commercial brands acted somewhat more rapidly than the others, all being toxic without exception. The average length of life of the nymphs when feeding from leaves coated with these materials varied from two to three days. In contrast the checks lived for an average period of one week. Over 500 individuals of this species were kept under observation on sprayed potato leaves, and in not a single instance did one mature, unless very near the transformation stage when placed in the vial. Approximately a sixth of them moulted once, and in two cases two moults were observed. The majority died before ecdysis. On the other hand a relatively large proportion were reared to maturity in the vials on unsprayed leaves.

TABLE I. EFFECT OF BORDEAUX SPRAY UPON *Empoasca mali* NYMPHS

Treatment	Number of Days Insects Lived			Number of tests
	Maximum	Minimum	Average	
4-4-50	8	1	3.12	164
4-4-50+Kayso	5	1	3.15	20
8-4-50	4	1	2.95	61
Glidden	6	1	2.39	78
Grasselli	6	1	2.37	67
Sherwin-Williams	7	1	2.08	56
Untreated	17	1	7.24	61

As previously shown,[2] the five instars vary in susceptibility to this spray compound, the first succumbing most rapidly, the fifth being the most resistant (Table II). Adults seem to be comparatively immune to this mixture, for several of them have been kept alive as long as 15 days while feeding on sprayed leaves. The effect at this stage is, chiefly of a deterrent nature.

[1]Fenton, F. A. and Hartzell, A. Journal of Economic Entomology, Vol. 15 pages 295-298, 1922.

[2]Fenton, F. A. and Hartzell, A. loc. cit.

TABLE II. EFFECT OF BORDEAUX SPRAY UPON DIFFERENT INSTARS OF *Empoasca mali*

Stage	1	2	3	4	5	6
Average number of days insects lived on sprayed leaves	1.56	1.7	2.06	2.5	2.58	4.55
Control	2	2.16	3.07	3.2	3.39	5.81

The susceptibility of *Empoasca mali* nymphs to Bordeaux spray suggested the possibility of its effectiveness against certain other leafhoppers. Accordingly similar experiments were made with *Empoa rosae*, *Erythroneura comes* and *E. tricincta*, the three species feeding upon apple, and cultivated and wild grapes, respectively. Leaves of these plants were sprayed with this compound and the nymphs confined in vials for observation. Checks were used in all cases. The results are summarized in Table III. Bordeaux was decidedly toxic to these species under cage conditions. When fed on sprayed leaves these nymphs behaved in practically the same manner as those of *Empoasca mali*. The mortality was high, successful ecdysis rare, and none were reared to maturity. It was comparatively easy to rear them through all stages upon untreated leaves.

TABLE III. EFFECT OF BORDEAUX SPRAY UPON THREE SPECIES OF LEAFHOPPER NYMPHS

Species	Number of days lived on sprayed leaves			Number of tests	Control			No. of controls
	Maximum	Minimum	Average		Maximum	Minimum	Average	
E. comes	10	1	2.8	47	22	1	7.78	23
E. tricincta	7	1	2.53	47	8	1	4.4	10
E. rosae	5	1	2.5	23	9	1	5.5	10

In view of the fact that Bordeaux mixture might possibly be toxic under these conditions and not effective in the field, the following experiment was tried out with *Empoasca mali*. A plot of potatoes was sprayed three times, June 8, July 3 to 5, and July 27. Records were taken of the leafhopper infestations on sprayed and unsprayed plants Table (IV). Weather permitting, daily counts were made of the total nymph population on individual plants selected at random from the treated and check rows. The average daily count for one check plant was 50 while the sprayed vines averaged from 12 to 22. Such a difference as this cannot be explained entirely as the result of a repellant action of Bordeaux upon this species, because frequent rains occurred directly after spraying and washed off a certain amount of the material. Moreover, plenty of unprotected leaves were exposed for oviposition owing to plant growth between spray applications, especially since the

female leafhopper prefers the growing tip for this. These factors tended to offset partly the deterrent action of this material. Therefore, as the insects were left undisturbed after each observation was made, it is believed that these records represent a true insecticidal action of this compound to the nymphs. The apparent discrepancy between the length of life of certain of the plants after the counts were begun, and the relative daily nymph count, was due to the greater size and vigor of these, which was general throughout one side of the field. This was not the result of better protection afforded by any one type of Bordeaux mixture, as check rows located at regular intervals throughout the plot showed this to be due to more favorable conditions for plant growth at this part of the field. These larger plants not only lived longer but supported a somewhat larger leafhopper population.

TABLE IV. SUMMARY OF FIELD COUNTS ON PLANTS SPRAYED WITH BORDEAUX MIXTURES

Treatment	Number of plants	Average No. of nymphs per plant	Average life of plant after infestation	Average daily No. of nymphs per plant
4-4-50	4	848.7	37.25 days	22.7
Glidden	4	493.5	39.5 "	12.49
Grasselli	4	746.75	41.75 "	17.8
Sherwin-Williams	4	894.75	44.5 "	20.0
Control	1	1350	27 "	50

The above tests indicate that Bordeaux mixture is a specific insecticide for at least one and possibly four species of leafhoppers, namely *Empoasca mali*, *Empoa rosae*, *Erythroneura comes* and *E. tricincta*. They appear to substantiate the previous statement by the senior writer that Bordeaux not only protects potato vines from leafhopper attacks by its repellant action on the ovipositing females but that it also protects them because of its toxicity to the nymphs. It should therefore be classed as a specific insecticide for leafhoppers of certain types.

VACUUM FUMIGATION EXPERIMENS WITH BROWN TAIL MOTH AND EUROPEAN CORN BORER LARVAE UNDER WINTER CONDITIONS

By R. I. SMITH, *Boston, Mass.*

ABSTRACT

Fumigation of brown-tail moth, *Euproctis chrysorrhoea* nests, in mid-winter show that brown-tail moth larvae were killed when fumigated at 50° F., and in many cases when the temperatures were as low as 39° F. European corn borer larvae, *Pyrausta nubilalis*, taken from a storeroom at a temperature of 40° to 45° F., and fumigated in a temperature of 65° to 70° F., were not killed. Borers frequently counted as dead from two to fourteen days after fumigation were found to recover

and even complete their transformations. The experiments, with few exceptions, represented two hour fumigation periods, much better results being obtained when the time was extended to from six to ten hours.

On February 8, 1921, Mr. E. R. Sasscer of the Federal Horticultural Board wrote that French fruit seedlings had been arriving at frequent intervals infested with the brown tail moth nests. He said the question had arisen at the Board meeting that day as to whether or not it would be possible to safeguard nursery stock bearing brown tail nests by fumigating at the vacuum fumigation plants with the same dosage of cyanide as employed in the fumigation of cotton. He had been instructed by the Board to ask me to immediately secure brown tail nests and commence a series of experiments to settle the point in question. I made plans immediately and a large supply of nests containing at least 85% living larvae were furnished at my request, by Mr. A. F Burgess of Melrose Highlands.

It should be clearly understood that all the experiments I shall mention today were made in connection with the commercial fumigation of imported cotton as required by the Federal Horticultural Board. The method, as many of you know, is the introduction of hydrocyanic acid gas into the cotton while under a 25" vacuum. A dosage of six ounces NaCN to 100 cubic feet and a period of two hours is required for all ordinary raw cotton. All of my experiments with brown tail and European corn borer larvae were made with the above charge of cyanide.

My first experiment with brown tail nests was made February 15, 1921. The temperature was 27 degrees Fahr. Fifty nests were fumigated. None of the larvae were killed. Two days later, February 17th, over 150 nests were fumigated at a temperature of 50 degrees Fahr. and all larvae were apparently killed. On February 23d about 100 nests were fumigated at 38 to 39 degrees Fahr. In one nest 173 living larvae and 411 dead were found. In seven other nests the average number of larvae alive was less than 12 each. Sixteen other nests were examined with the result that all the larvae were found dead. On March 1st out of 50 nests fumigated at 45 degrees Fahr. only 2 larvae were found alive in 13 nests examined. On March 7th, 50 nests fumigated at 43 degrees Fahr. resulted in finding 7 larvae alive in three of the ten nests examined. On March 11th, among 50 nests fumigated at 48 to 49 degrees Fahr. we found all larvae dead in ten nests examined. On March 17th, 50 nests were fumigated at 49 degrees Fahr. and all larvae found dead in ten nests examined. On March 22d, 50 nests were fumigated at 42 to 43 degrees Fahr. with the result that all larvae were found dead in five

nests examined. On March 25th, 50 nests were fumigated at 56 to 57 degrees Fahr. and resulted in finding all larvae dead in the nests examined.

In all, 35 experiments were made between February 15th and March 25th, 1921, and without any exception brown tail larvae were killed when fumigated at 50 degrees Fahr. and in many cases when fumigated at temperature as low as 39 degrees Fahr. Even more careful experiments were made in 1922 between the dates of March 6th and May 9th. On the latter date the larvae were crawling in great numbers.

The 1922 experiments confirmed the results obtained in 1921 with one exception. On April 8, 1922, 40 nests fumigated at 51 degrees Fahr. resulted in the finding of 9 larvae alive among 716 which had emerged from the nests prior to fumigation. With this exception the 1922 experiments, 37 in all, proved that the brown tail larvae were always killed at temperatures of 50 degrees Fahr. or above. In many instances they were all killed at 47 degrees Fahr. In one instance they were all killed at 40 degrees and in another at 42 degrees Fahr. In each experiment from 30 to 40 nests were fumigated. In view of all this work I feel absolutely assured that the brown tail larvae in their winter nests may ordinarily be effectively killed if fumigated at a temperature of 50 degrees Fahr. or higher. It should be understood that this fumigation work was all conducted in the large fumigation cylinders used for cotton fumigation.

European Corn Borer Experiments

About one month after commencing the brown tail experiments in 1921, I decided to work with European corn borer larvae under the same conditions. A large supply of borers in corn stalks was furnished by Mr. Caffrey of Arlington. The corn borer experiments were commenced on March 17, 1921 and continued that year until April 25th. The results were very unsatisfactory. Twenty-one experiments were made. The number of borers removed from the infested corn stalks after each experiment, varied from 27 to 142, an average of about 75. Some very contrary results were recorded. The first experiment on March 17th resulted in 74 borers being all apparently killed at a temperature of 49 degrees Fahr. but on March 21st, 52 borers fumigated at 76 degrees Fahr. resulted in only 94% being killed. One month later, April 21st, 72 borers were fumigated at a temperature of 54 degrees Fahr. and only one survived. On April 23d, 71 borers fumigated at 46 degrees Fahr. were all apparently killed and on April 25th, 37 borers fumigated at 50 degrees Fahr. were all apparently killed. Referring again to the record of 52 borers fumigated March 21st at 76 degrees Fahr.,

I know now that that result was not entirely reliable. In other words, the borers themselves having been taken from a cool storage room had not responded in activity to the 76 degrees temperature. Likewise the good results obtained when fumigating at lower temperatures were not always reliable because the borers had sometimes been subjected to warmer weather for two or three days just prior to fumigation and were more easily killed than they would otherwise have been.

Much more exhaustive experiments with the corn borers in 1922 were made, taking advantage of the knowledge already gained the previous year, but the results were equally unsatisfactory. Sixty-five experiments were made from February 6 to June 8. From them it was determined definitely that borers taken from a storeroom at a temperature of 40 to 45 degrees Fahr. and fumigated in an atmosphere of 65 to 70 degrees Fahr. could not all be killed. It was also determined that borers which survived one fumigation at any temperature were often able to survive a second fumigation, some times at a higher temperature, and the records show that one individual borer was fumigated five times before it was finally killed at a temperature of 78 dgrees Fahr. I am forced to conclude that vacuum fumigation with a six ounce charge of cyanide is not effective against corn borers.

In the course of these experiments a surprising condition was discovered. Borers were frequently counted dead for from two to fourteen days after fumigation and then recovered. Many borers that did recover in this manner were placed under incubation conditions and were frequently reared to moths at the Arlington Corn Borer laboratory. It must be concluded that if borers survive the cyanide fumigation they are not weakened to any appreciable extent. It was also found that the large mature-looking borers were no more resistant to the gas than the small immature specimens. It should be explained that all the experiments, with a very few exceptions, represented two-hour fumigation periods. Much better results were obtained in general in the few experiments made when the time of fumigation was from six to ten hours. I feel safe in asserting that a continuous four-hour fumigation is more effective than two separate two-hour fumigations, other conditions being equal.

In view of all my experiments I believe that imported nursery stock may be safeguarded against brown tail moth larvae by fumigation at a suitable temperature, but I do not believe that importation of any

material liable to contain corn borers may be safeguarded by fumigation. It is seldom that material arrives when the temperature is above 75 or 80 degrees Fahr. as would be necessary for certain results against the corn borers.

A STUDY OF THE FACTORS AFFECTING THE OUTDOOR WINTERING OF HONEY BEES

By GEORGE E. KING, *Department of Entomology, Univ. of Ill.*

ABSTRACT

This investigation was carried on under regular apiary conditions to study the variable factors entering into the outdoor wintering problem.

During a severe winter strong colonies with heavy, medium, and light winter-packing and ample stores suffered a loss in their population in an inverse ratio to the degree of protection given them. Populous colonies slightly protected consumed per unit of population much less stores than weak colonies. Those having a minimum of stores, regardless of packing or population, failed to winter as well as those having ample stores.

SYNOPSIS OF RESULTS

This investigation was undertaken for the purpose of studying some of the more obvious principles underlying the successful outdoor wintering of honey bees. It was carried out under regular apiary conditions at the Utah Agricultural College, as an investigation under project No. 50 of the Utah Agr. Experiment Station.

The wintering problem is one of great complexity, the solution of which lies in the determination of the resultant of a number of interacting variables. The most obvious of these variables are such factors as: strength of the colony, age of the bees, quality and age of queens, the quality and quantity of stores for winter, temperature and humidity relations, housing and protection, light relations, etc.

A colony of bees is a complex dynamic unit composed of individuals that are constantly changing. Since the changes taking place in the colony are so varied and rapid, there is little possibility of reducing the technique of investigation to more than a fairly accurate approximation. The aim has been to obtain the desired data by direct and simple methods and through uniformity of procedure rather than by elaborate processes so as to carry the work on under the actual working conditions of the bees.

The twenty-six colonies of bees used in this work were numbered and divided into four groups. The quantity of stores and condition of each colony as regards the number of bees and their relative vigor and age

were determined as accurately as possible. Each group of colonies was packed for winter during late October or early November 1921, in a different manner. One of the methods of packing was possible with but one colony, so that the results in that one case are not conclusive. The other three groups each consisted of from seven to ten colonies.

The methods of packing were representative of three degrees of protection. The least protection given was by means of stacking colonies in single and two-story brood chambers, with entrances reduced to ⅜″ × 3 in., facing them south and covering all except the fronts of the hives with tarred paper. A medium protection to a row of two story hives, placed side by side and facing south, was afforded by a layer of 2–3 inches of planer shavings, and a thickness of tarred paper surrounding the stack on all sides, leaving only a ⅜″ × 3″ opening at each hive entrance. A thorough protection was afforded a group of eight colonies by packing them in quadruple cases with at least ten inches of planer shavings surrounding them, leaving an outside entrance of 2½″ × 7/16″.

The winter of 1921–22 in northern Utah proved to be one of the coldest recorded in about thirty years, although sufficient snow fell to partially cover the colonies during the coldest weather.

In order to learn the results of wintering, the activities of all colonies were carefully observed during late winter when the bees were likely to fly out and their condition and strength checked as promptly as was possible at the beginning of spring. While drifting was an almost negligible factor, the averaging of results has been made in such a manner as to avoid error from that source.

The results show that a relatively greater quantity of stores are consumed by a unit population of bees in weak colonies even though they are well protected, than is necessary for the same number of bees in a strong colony even with much less protection. Colonies with a minimum of stores failed to winter as well, or as economically as those well supplied with stores, regardless of the population of the colony or the thoroughness of the packing. The idea expressed by many beekeepers, that the sunshine warms up and benefits colonies left with their fronts uncovered was not borne out by these observations. The bees ventured out less on bright cool days from colonies housed in double brood chambers with small low entrances than from those in which light could enter more freely. This resulted in the loss of fewer bees from flights in cool weather, from the protected colonies and much more rapid spring breeding.

Strong colonies wintered in double brood chambers with ample stores and reasonable protection, set with their entrances near the ground

showed a total average loss of but 2.1+% of their bee population, whereas the loss from equally populous colonies in hives having their fronts exposed was about 4%. The loss in the population of colonies wintered in single hive bodies ranged much higher.

The disposal of moisture from the colonies may be effected almost entirely through the entrance, provided the bees are warmly packed. The only moldy combs found were in hives in which the frames hung to within ⅜ inch of the bottom board, affording a condition in which dead bees and refuse piled up against the combs. Colonies having ample stores and protection not only wintered better but began heavy breeding much more promptly at the opening of spring than those not so supplied.

While the amount of data from this work is insufficient to permit the drawing of final conclusions, it nevertheless points out rather definitely some of the reasons for the loss of the bee population during winter and the requirements to prevent that loss. Further experiments should be undertaken and carefully prosecuted on a more intensive and extensive scale, so that as many as possible of these interacting variables might be considered simultaneously and the results treated as a unit rather than as isolated phases of the same great problem.

FUMIGATION OF WASHINGTON BARRACKS AND ARMY WAR COLLEGE BY THE CHEMICAL WARFARE SERVICE

By HARRY A. KUHN, *1st Lieut., C. W. S., U. S. A.*

The Chemical Warfare Service, by the research and investigation incidental to its fundamental role of providing our nation protection against the possible use against our armed forces or our civilian population of chemical warfare agents by an unscrupulous enemy, is producing by-products of great value to art, science and industry.

In co-operation with government departments and scientific, industrial and educational organizations, it is making a distinct contribution to the beneficent use of scientific knowledge.

The following report covers an incident in the work of developing a safe and more efficient method of ship fumigation.

The cyanide compounds, owing to their ability to produce rapid incapacitation and rapid death, were investigated quite extensively by the research organizations of the Chemical Warfare Service during the past World War. Hydrocyanic acid, cyanogen chloride, cyanogen bromide, cyanogen sulphide, methylcyanoformate, powdered sodium cyanide and various other organic and inorganic compounds containing

the cyanide radical were discarded for various reasons, the principal reason being the inability to build up and maintain a sufficiently high concentration in the field owing to their low density. When the Public Health Service in 1922 requested the assistance of the Chemical Warfare Service in finding either a compound which could be released with hydrocyanic acid to make the presence of hydrocyanic acid more noticeable or to develop a substitute for hydrocyanic acid in ship fumigation this data on cyanide compounds was made available to them.

After some little experimental work it was found that although a lachrymator could be very readily released with hydrocyanic acid the lachrymator persisted after the cyanide had been cleared out of the ship's hold. Work was then begun on a substitute for hydrocyanic acid. This substitute was to be as toxic to rodents and vermin as hydrocyanic acid; must either have a powerful odor or be a lachrymator so that its presence could be easily detected. It must also be readily generated in place in similar fashion to that used for generating hydrocyanic acid, i.e. by dropping a relatively inert cyanide compound into an acid where a more active cyanide gas was formed. The compound must also be very volatile and as readily cleared out of the ship's hold as hydrocyanic acid. After considerable experimentation in conjunction with the Public Health Service cyanogen chloride, generated by dropping the desired amount of granulated sodium cyanide and sodium chlorate into dilute hydrochloric acid, was selected as possessing all the qualifications of hydrocyanic acid. Cyanogen chloride is almost as toxic to insects and vermin as is hydrocyanic acid and in addition is a vigorous lachrymator. It was found to be a very good germicide which is not true for hydrocyanic acid. Cyanogen chloride, generated in this manner, was tried out and proved effective in ridding various buildings at Edgewood Arsenal of rats, mice, bats, roaches and bedbugs. In addition work has been carried out by the Public Health Service against other sorts of vermin and germs, both in the laboratories and on board ship. This gas will soon be used by the Public Health Service on all ship fumigation carried on under that bureau.

The Quartermaster of Washington Barracks requested the Chief of Chemical Warfare Service to try cyanogen to rid various buildings at Washington Barracks and the Army War College of roaches and ants which had increased to such a number, despite insect powders of all sorts, that they had reached the proportions of a plague. This report covers the fumigation of these buildings at Washington Barracks and the Army War College. The buildings included the Post Quartermaster's

office, which was infested with roaches and ants; the Barracks mess hall kitchen and store rooms infested with roaches; the Army Music School mess hall, kitchen and store room which were infested with roaches and bedbugs; non-commissioned officers' quarters infested with bedbugs; and an officer's residence infested with red ants; the record rooms, executive offices and the commanding general's office of the Army War College which were infested with ants and roaches. The cubic contents of the buildings gassed ranged from 20,000 to 200,000 cubic feet. The maximum concentration used was six ounces of sodium cyanide mixed with three ounces of sodium chlorate per 1,000 cubic feet. This concentration was used in the Quartermaster's office, mess halls and the non-commissioned officers' quarters. For the officers' residence and the Army War College the sodium chlorate was reduced to one and one-half ounces with six ounces sodium cyanide per 1,000 cubic feet.

The gas was generated by dropping bags made of two thicknesses of cheese cloth containing six ounces of sodium cyanide, crushed to about the size of a bean, mixed with the required amount of granulated sodium chlorate into a three gallon crock containing 1,500 cubic centimeters commercial hydrochloric acid which had been diluted with 1,500 cubic centimeters cold water. With a three gallon crock such as we used, double charges sufficient for 2,000 cubic feet, i.e. twelve ounces of sodium cyanide, six ounces sodium chlorate, three liters of commercial hydrochloric acid and three liters of water, can be used. The gases are a mixture of cyanogen chloride and hydrocyanic acid, generated according to the following formulae:

$$3\,NaCn + NaClO_3 + 6\,HCl = 4\,NaCl + CnCl + 3\,H_2O$$

$$Na\,Cn + HCl = NaCl + HCn$$

The usual time of exposure was two hours, with the exception of the non-commissioned officers' quarters where the time of exposure was three hours. It was found that bedbugs required longer time of exposure to kill than do roaches. The buildings were aired out by opening the windows and in every case they cleared out so that it was not necessary to use a gas mask within one-half hour. The casualties on roaches, ants, bedbugs, rats and mice were practically one hundred per cent. There was no evidence of corrosion of any sort of metal or any injury to any sort of fabric in any of the dwellings or buildings gassed. In the dwellings there were pianos, victrolas, brass beds, silver ware, bronze statuary and clothing of all sorts which were uninjured. In one of the mess halls there was a large rubber plant and two aspedistra plants all of which were placed close around one of the generators and after the gassing

showed no injurious effects. It was not possible to try the effect of cyanogen chloride on young growing plants. There was very little evidence of the formation of either free chlorine or chlorine dioxide with a mixture of four parts of sodium cyanide to one of sodium chlorate and it is thought that this ratio could be very safely used even against young growing plants.

Scientific Notes

Do Rats Eat Mealybugs? Several observers have noted that where mealybugs (*Pseudococcus spp.*) occur on sugar cane in some tropical countries stalks will be found with the leaf sheath gnawed through in one or two places and the mealybugs which were on the stalk underneath no longer there. An entomological friend, though he had not seen any animal doing this work, assumed that it had been done by rats, which he thought gnawed through the leaf sheath to feed on the mealybugs. A bulletin has now been issued by another worker in another country giving credit to rats for this aid in control, but again the rats have not been seen in the act.

As far as I know rats may feed on mealybugs, but at Mercedes, Cuba, on September 12th, 1918, I noticed the large reddish ants common in Cuba carrying mealybugs away in their mandibles through holes in the leaf sheaths which they had undoubtedly gnawed. Specimens of the ant were afterwards determined by Dr. W. M. Mann as *Atta insularis* Guer. I have the specimens before me with the note which I made at the time.

While the matter is perhaps of little economic importance, it might be just as well not to credit rats with a partial control of the sugar cane mealy bugs until more definite observations have been made. It might be mentioned that though mealybugs occur on sugar cane in Louisiana this gnawing of the leaf sheath has never been observed. Rats are present, but large species of ants are not.

T. E. Holloway, *U. S. Bureau of Entomology*

Colorado Potato Beetle in France. The readers of the JOURNAL may be interested in the recent outbreak of the Colorado potato beetle in France, reported in a special number of the *Revue de Zoologie Agricole*, published in August 1922. The paper is entitled, "Le Doryphore. Chrysomele nuisible a la pomme de terre (*Leptinotarsa decemlineata* Say)," by Jean Feytaud. This beetle was discovered on June 9, 1922, at Taillan in the Department of Gironde and was later found rather widely scattered throughout the department in the general vicinity of Bordeaux. It is believed to have been introduced accidentally in importations from America in 1919 or 1920.

An interesting feature is the fact that within five weeks after discovery an emergency appropriation of five hundred thousand francs had been made available for control measures and that the former law, which refused indemnity to the owners of fields destroyed, had been amended in this respect. Within the same period extensive machinery has been organized for control measures, including departmental committees of defense.

Dr. Feytaud's paper not only discusses this outbreak and the plans for eradication or control but includes a most interesting and exhaustive outline of the various discoveries of the Colorado potato beetle in Europe from the time this species reached the Atlantic coast in the United States in April, 1875, to the present. These outbreaks which were more numerous than seems to be generally understood in this country, have all resulted in complete extermination up to the present time with the possible exception of one at Hohenwedel, Germany, in 1914, about which there seems to be inadequate information.

The activities in France, in connection with this new outbreak and the successful campaigns of the past are particularly interesting, in view of the several entomological eoradication projects under way in the United States at the present time.

S. B. FRACKER, *Madison, Wisconsin*

Note on a Bombyliid Parasite of the Pale Western Cutworm (*Porosagrotis orthogonia* Morr.) During several past seasons extensive rearings have been made of *P. orthogonia* from collections of larvae made in various parts of Montana, and a considerable amount of data accumulated upon the occurrence and abundance of parasites. Until 1922 only two Dipterous parasites, *Bonnetia compta* Fall. and *Pleteria robusta* Wied., have been reared from this species. Both of these are Tachinidae.

In 1922 we found among our Noctuid pupae which were supposedly ready for emergence several actively moving pupae of a Bombyliid fly. These moved actively about for a few hours, then became quiescent upon the soil surface, and the flies emerged about two days later. The fly has been determined for us by Mr. J. M. Aldrich of the U. S. National Museum as *Anthrax* sp. and fifteen were reared from 116 larvae caged, or about 13%.

A search of the economic literature brings to light the parasite recorded by Allen from the Southern Grass Worm (*Laphygma frugiperda* S. & A.) (Journal Ec. Ent. 14; 510, 1921) as the only recent record of a Bombyliid as an economic factor in cutworm control. The fly (*Anthrax lucifer*), reared by Allen, has a life history precisely similar to our species of *Anthrax*, so far as observed.

This fly is apparently confined to *P. orthogonia*, as extensive rearings of several other common species of Noctuids, including *Euxoa pallipennis*, *E. dargo*, and *Porosagrotis vetusta*, failed to disclose a single specimen of *Anthrax*.

WILLIAM C. COOK, *Montana Agricultural Experiment Station*

Calcium Cyanide Dust as an Insecticide. In August and September, 1922, 25 or 30 orange and lemon trees were fumigated by blowing finely powdered calcium cyanide under tented trees to determine the effect of such material on citrus trees and on the scale insects infesting them. The trees were infested with the black, red and citricola scales and a complete kill of these scales was effected without any injury to the trees. Other trees were fumigated in the same way later in the season when rains and moist weather followed with the result that, while the scales were killed, some injury to the trees was apparent. The injury, however, appeared to be only temporary. During a dry period in January, one or two other trees were fumigated without injury. Moisture seems to be an important factor in connection with the possible use of powdered calcium cyanide as a tree fumigant, and further work to determine its effect is now in progress.

Powdered calcium cyanide has also been used as a soil fumigant, and results thus

far indicate that this form of cyanide is well adapted for soil fumigation. Hydrocyanic acid gas is readily given off and the powder is easily applied in the soil. It would be possible to apply it in the soil on a large scale by means of a drill. Woolly aphis and other soil infesting insects have been killed with the use of 2 oz. per sq. yd. Little has been determined thus far as to the effect of the powder on the roots of trees but the indications are that it is less injurious than a solution of any form of cyanide.

A few preliminary experiments have also been made with the peach root-borer. Where the material was applied directly to the tree a good kill of the borers resulted, but the effects on the tree remain to be determined. It is also planned to make tests against nematodes where these occur with normal crops. It has already been used with considerable success against ground squirrels. The University of California Citrus Experiment Station is engaged in an investigation of the uses of powdered calcium cyanide as an insecticide and, at the present time, the work has proceeded far enough to indicate merely some of the possibilities rather than to make any definite claims supported by sufficient data.

H. J. QUAYLE, *Citrus Experiment Station, Riverside, Calif.*

Calcium Cyanide for Chinch Bug Control. Experiments with Calcium Cyanide for control of the chinch bug were started at Illinois, in June 1922. The material was used at first in flake form, as this was the only form procurable, at that time. It was scattered along the margins of stubble fields, from which chinch bugs were migrating to the corn, and used along barriers where the bugs were stopped in their migration from the small grain fields. When scattered over the ground, in a strip, three inches wide, and sufficiently thick, so the flakes were not more than an eighth of an inch apart, it was found that this material would kill every bug crossing it, for one hour to three hours, depending on the temperature, the amount of moisture in the soil and the humidity. The flake material was scattered around the base of hills of corn, and behind the sheathes of lower corn leaves, heavily infested with chinch bugs. Practically 100% of the bugs on the corn hills treated in this way, were killed, where they were feeding within three inches of the Cyanide flakes.

During the latter part of the summer, a dust cyanide was secured, and was tried at strengths of 3, 6, 9 and 12% in a ground spent tobacco dust carrrier. The 3 and 6% strengths, gave only a fair degree of kill, when dusted on chinch bugs in grass or behind leaves of corn stalks. The 9 and 12% strengths gave a much better kill, the 12% killing about 95 to 98% of the bugs, within three inches of the point of application.

During the past winter, this material has been tested, on hibernating chinch bugs, placed in wheat and on the bare earth in a greenhouse. The results obtained from these experiments have confirmed the work of the previous summer. Extensive field experiments, to test the effect of this material combined with different carriers, and at different strengths, will be carried out in Illinois and neighboring states, during the coming season. If the material proves as effective as indicated by the experiments of last year, it will be possible to use it for field applications, against the chinch bug. The cost of such application would not be so high, that it would be impractical for a farmer to use it.

W. P. FLINT, *State Entomologist, Natural History Survey, Urbana, Illinois*

Preliminary Announcement of Meeting, Pacific Slope Branch, American Association of Economic Entomologists

The next regular meeting of the Pacific Slope Branch of the American Association of Economic Entomologists will be held in connection with the Pacific Division A. A. A. S. at the University of Southern California, Los Angeles, Cal., September 17, 18, 19, 1923. A partial program has been suggested as follows: Tuesday, Sept. 18—At University So. California, Los Angeles, Cal. Forenoon—Business Meeting. Afternoon—Symposium on Dusting, R. E. Campbell, leader. Evening—Round Table Discussions, G. P. Weldon, leader. Wednesday, Sept. 19—Branch State Insectary, Whittier, California. All day symposium on Biological Control of Insects, H. S. Smith, leader. Evening—Dinner and Speeches. We shall be glad to have you submit topics of papers on any general subject of Economic Entomology which you may choose. Because of the lack of space and cost of printing, may we request that each member submit only one paper for publication in the proceedings, but may present as many at the meeting as desired. There is so much entomological work in progress in Southern California that we are looking forward to a large attendance at the meeting this year and trust that you can arrange your work to be present.

E. O. Essig, *Secretary*
E. R. Campbell, *Acting Chairman*

Summer Meeting

The entomologists of the northeastern United States will hold their summer meeting this year in Connecticut the latter part of July, probably July 26 and 27. Entomologists should bear this in mind and be ready to engage accommodations as soon as definite arrangements can be announced. Further information will be sent by mail to members.

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The air as a medium of dispersion deserves more than a passing thought. Insects are well known inhabitants of the air and it has long been known that apterous spiders make long voyages with no more stable support than a gossamer web. Later investigations have shown that small caterpillars may literally drift upon the "wings of the wind" and in the case of young caterpillars of the gipsy moth this is known to be a most important method of spread. It is evident that the lower wind currents are very important aids to the spread of insects and yet relatively little is known concerning them. The part winds play in the spread of insects has a very material bearing upon the proposed barrier zone which may be established in New York State to prevent the westward trend of the gipsy moth. A series of temporary weather stations have been established in western Massachusetts and Connecticut and a few in adjacent portions of eastern New York for the purpose of securing data on the direction and velocity of the winds at the time young gipsy moth caterpillars are likely to be carried and in addition toy balloons are being liberated on definite schedules from a series of stations for the purpose of supplementing the data obtained from the weather stations. This extension of earlier work of federal men and in co-operation with them bids fair to yield some most interesting results.

Current Notes

The nursery inspection work in North Dakota is now in charge of Professor R. L. Webster.

The office of the State Entomologist of Illinois has been merged into the Illinois State Natural History Survey.

The North Dakota legislature recently passed a foulbrood law and Professor R. L. Webster has been appointed state inspector for apiaries.

Mr. George Knowlton, a graduate student, is acting field man in Entomology at the Agricultural Experiment Station, Logan, Utah.

Professor George A. Dean, of the Kansas Agricultural College, Manhattan, visited Washington April 24 to attend the meeting of the National Research Council.

Dr. W. D. Hunter of the Bureau of Entomology addressed the annual meeting of the Texas Cotton Association at Dallas, Tex., on March 24.

The following resignations from the Bureau of Entomology have been announced: Dr. H. L. Dozier, Dr. William Moore, H. L. McIntyre, J. C. Bridwell, and H. P. Wood.

At the North Dakota Agricultural College the department of entomology is being provided with increased quarters in the new agricultural building recently completed.

Professor J. S. Houser of the Ohio Station attended a grape growers' conference at North East, Pa., on March 6, and conferred with entomologists concerning spraying programs.

According to *Science*, Dr. C. A. K. Marshall, Director of the Imperial Bureau of Entomology, London, England, has been recommended for election to membership in the Royal Society.

Professor S. B. Freeborn, Assistant Professor of Entomology in the College of Agriculture, University of California, has been granted a sabbatical leave of absence for study and travel.

Dr. I. M. Hawley, head of the Department of Zoology and Entomology at the Utah Agricultural College, has been made Acting Dean of the College of Arts and Sciences, for the coming year. Dean Saxer will be away because of poor health.

H. J. Pack, Assistant Professor of Zoology and Entomology of the Utah Agricultural College, will be away on leave to do graduate work at Cornell University. His substitute has not been definitely appointed at this time.

Mr. Don Gill is instructor in apiculture at the Utah Agricultural College. The college has an apiary of thirty-two colonies. The courses given are primarily for disabled soldiers, and at times forty men have been registered in this work.

Dr. William Moore of the Japanese beetle laboratory, Riverton, N. J., resigned in February to accept a research position with the American Cyanamid Company in New York, N. Y.

Professor H. B. Hungerford of the University of Kansas, will be one of the teachers at the University of Michigan Biological Station, Douglas Lake, Mich., July 2 to August 24.

The United States National Museum has recently received, as an exchange from the British Museum, about 300 species of Old World Orthoptera, most of which are new to the collection.

Transfers in the Bureau of Entomology have been announced as follows: A. C. Mason, Orlando, Fla., to Lindsay, Calif.; A. J. Flebut, Fresno to Lindsay, Calif.; E. R. Van Leeuwen, Medford, Ore., to Riverton, N. J.

Mr. Samuel T. Sealy, deputy in charge of mosquito control work in Connecticut, resigned April 1, and the work has been assigned temporarily to Mr. B. H. Walden, Assistant Entomologist of the Connecticut Station.

Dr. E. A. Back of the Bureau of Entomology gave an address on insects attacking upholstered furniture before the National Association of Upholstered Furniture Manufacturers, on April 11, at the Hotel Traymore, Atlantic City, N. J.

Mr. G. F. Moznette of the Bureau of Entomology with headquarters at Miami, Fla., attended a meeting of the State Horticltural Society at Orlando, April 16, and gave advice on tropical and subtropical fruit insects.

Mr. Harold E. Woodworth, formerly professor of entomology at the University of the Philippines, Los Banos, has resigned his position and is at present connected with the California Spray Chemical Company with headquarters at Watsonville.

Dr. J. M. Swaine has been appointed Associate Dominion Entomologist in place of Chief, Division of Forest Insects, and will assist the Dominion Entomologist in the general work of the Branch, particularly that pertaining to research.

Mr. C. M. Smith of the Bureau of Entomology read a paper entitled "Excretion from Leaves as a Factor in Arsenical Injuries to Plants," at the meeting of the American Chemical Society, New Haven, Conn., April 2-7.

According to *Science*, Dr. Vernon Kellogg gave a series of three lectures on March 13, 14 and 16 at Princeton University on "Kinds of Minds." These lectures will be published in book form by the Princeton University Press.

According to *Science*, Professor A. C. Burrill has resigned as extension entomologist of the University of Missouri, to accept a position as curator with the Missouri Resources Museum Commission in the new State Capitol Building, Jefferson City, Mo.

The Thomasville, Ga., substation of the Bureau of Entomology has been discontinued on account of the light infestation of the bean beetle during the past season, and the fact that available funds no longer permit the maintenance of this station.

The following appointments to the Bureau of Entomolgy have been announced: H. S. Adair, Fort Valley, Ga.; C. K. Fisher, Junior entomologist, Alhambra, Calif.; Wm. D. Mecum, Madison, Wis.; temporarily for Japanese beetle quarantine service, F. H. Wersinger Jr., G. B. Stichter, C. H. Buckman; insecticide investigations, L. L. Golden.

Dr. John N. Summers of the Bureau of Entomology gipsy moth parasite laboratory at Melrose Highlands, Mass., who visited Japan last year to secure parsites of the gipsy moth, has gone to that country again and will continue his studies of the gipsy moth and its parasites.

On the evening of April 19th, W. R. Walton gave a lecture before the Manitoba Natural History Society at the University of Manitoba on the subject of "Some

Phases of Insect Parasitism," a purely popular treatment of the subject which will be published in the *Canadian Field Naturalist*.

According to *Science*, Professor and Mrs. T. D. A. Cockerell of the University of Colorado will sail on June 4 from San Francisco for Yokohama. Thence they will proceed to Vladivostock, in order to investigate a deposit of fossil insects recently discovered on the coast of Siberia, returning to America in September.

According to *Science*, Professor D. L. Van Dine, extension entomologist of the Pennsylvania State College, has been appointed one of the scientific trustees of the Tropical Plant Research Corporation, a newly formed organization, the objects of which are to promote research for the advancement of knowledge of the plants and crops of the tropics.

Mr. W. E. Haley of the Bureau of Entomology has started experiments in southern Louisiana with the new hot water treatment of sugar cane. It has been found that soaking the cane in water heated to a certain degree destroys borers in the cane and at the same time hastens the germination of the stalks when planted.

Dr. A. C. Baker will assist Dr. Quaintance in administrative work in the office of Fruit Insect Investigations, Bureau of Entomology. He will continue as custodian of the aphid and aleurodid collections, and will have time to pursue his studies in these families. A. C. Mason, under Dr. Baker's supervision, will devote all his time to the aphididae.

The results of the work of the Bureau of Entomology on insects affecting dairy cattle will be shown at the National Dairy Exhibit to be held at Syracuse, N. Y., next October. Practically every bureau in the department will have some part in the exhibit. It is expected that one booth will be devoted to entomological problems.

Dr. L. O. Howard, who is now abroad, has been made honorary president of the International Conference of Phytopathologists and Economic Entomologists, which is to be held at Wageningen, Holland, on June 21. Dr. Howard will also attend the International Congress of Agriculture at Paris May 22–26, and the international conference concerning *Dacus oleae*, to be held at Madrid on June 18.

Dr. C. W. Woodworth, director and chief entomologist of Kiangsu Province, China, spent Thursday, April 19, in the section of insects, U. S. National Museum, consulting some of the specialists in regard to specimens he collected. Dr. Woodworth's headquarters are at Nanking and he has associated with him the following Chinese entomologists as well as other workers: Goey Park Jung, C. Francis Wu, and Hai-san Chang.

The position of Assistant Professor of Beekeeping at the Massachusetts Agricultural College made vacant last fall by the resignation of Professor N. E. Phillips, has been filled by the appointment of Mr. Morton H. Cassidy, a graduate of the College who received his training in Beekeeping under Dr. B. N. Gates, and who has since that time been actively concerned himself, in Beekeeping. Prof. Cassidy began his work April 1.

According to the *Florists Exchange*, the Colorado potato beetle has made its appearance in France where nearly 100 square miles in the Bordeaux district are infested. Presumably it was carried from the United States to France in some kinds of produce, not necessarily potatoes. The British Government warns potato growers to watch for the pest and has prohibited the importation of plants and bulbs from the infested region in France.

At the spring meeting of the American Chemical Society in New Haven, the section of insecticides and fungicides on April 5 listened to papers by the following entomologists: Dr. E. D. Ball, Prof. W. C. O'Kane, A. E. Kelsall and Dr. William Moore. Mr. G. E. Sanders was on the program for two papers but was not present. Papers by P. J. Parrott and Hugh Glasgow and by P. J. Parrott and L. R. Streeter were read by Mr. Streeter.

Mr. E. Graywood Smyth, investigating the Mexican bean beetle for the Bureau of Entomology, sailed early in April for Puerto Barrios, Guatemala. From this point he will proceed to the interior in an endeavor to obtain additional parasites of the Mexican bean beetle suitable for introduction into the eastern United States. The territory in eastern Guatemala, high and subtropical in character, should furnish parasites capable of living in the southeastern United States.

Mr. A. J. Ackerman, Bureau of Entomology, in charge of apple insect investigations at Bentonville, Ark., and Prof. Geo. A. Dean, of the Kansas Agricultural College, met with fruit growers of the Arkansas Valley at Wichita, Kans., recently to discuss methods of aiding growers in the Wichita section in their fight against the codling moth during the coming season. Plans were made for co-operative work in the orchards at Wichita and at Belle Plain, Kans.

Mr. C. T. Dodds, candidate for a Ph.D., University of California, has recently been appointed to take charge of the parasitic control work of the Santa Paula Citrus Association representing some 10,000 acres of citrus trees in Ventura County, California. His work has to do chiefly with the control of the black scale by means of parasitic and predaceous insects which will be reared in a newly constructed and modern insectary. Mr. Dodds is abundantly qualified to take over this very important work.

According to *Science*, Professor F. L. Washburn of the University of Minnesota has returned from the South Pacific with a collection of several thousand specimens of insects for that institution from the Marquesas and Society Islands. Almost all orders are represented and sufficient material in the various families was secured to afford opportunity for exchange with other institutions. Most of this material was secured at from 200 to 300 feet above sea level, but many specimens were also taken at elevations of 1,500, 2,500 and 2,800 feet.

Mr. Samuel S. Crossman and Ray T. Webber of the Bureau of Entomology gipsy moth laboratory, Melrose Highlands, Mass., will visit Europe during the spring and summer of this year to secure beneficial species of parasites to aid in the fight against the gipsy and brown-tail moths. Mr. Crossman spent several months in Europe last year, and as a result of his observations it is believed important to continue the work of importing, breeding and colonizing of European parasites of the two insects. Material as collected will be shipped to the laboratory at Melrose Highlands, Mass.

Mr. H. G. Crawford of the Entomological Branch, Canadian Department of Agriculture, returned from a trip to southern Ontario on April 4 where he arranged for the beginning of the season's work. Considerable quantities of corn stalks were found to have been carried into Lake Erie by water from the spring floods. Material was also found frozen in the dislodged ice. This ice was later blown out into the lake by the winds from the north, suggesting a probable means of infesting the southern shore of Lake Erie.

Mr. T. E. Holloway has just returned from a six week's trip to the west coast of Mexico, including Lower California. Dr. W. M. Mann of the Bureau of Entomology, H. C. Millender of the Federal Horticultural Board, and M. Alcazar, delegated by the Mexican entomological service, made the trip at the same time and are now in Southern Mexico. A visit was made to Los Mochis, where R. H. Van Zwaluwenburg, entomologist of the United Sugar Companies and a former employee of the Bureau, is testing various control measures against the sugar-cane moth borer.

Beginning April 13, Dr. J. Chester Bradley of Cornell University spent seven days in the U. S. National Museum working on the collection of Hymenoptera and discussing a classification of the order with the various specialists. Dr. Bradley is preparing a classification of the Hymenoptera for Professor Comstock's new manual and in doing this he is seeking the co-operation of other workers, with the hope that they will be able to present an arrangement which will be generally acceptable to both American and European workers.

Dr. W. D. Hunter and B. R. Coad of the Bureau of Entomology attended the meeting of the Southern Agricultural Workers, held in Memphis, Tenn., from February 6 to 8. Mr. Coad delivered an address on boll weevil control. The following resolution was adopted at this meeting: "WHEREAS, The Cotton Belt is indebted to the United States Department of Agriculture through its representative, Mr. B. R. Coad, in charge of boll weevil investigation, for an effective method of boll weevil control and for the discovery of important entomological facts concerning the insect pests affecting cotton; Be it *Resolved*, That this Association expresses its high appreciation of Mr. Coad as a scientist and recognizes his invaluable contributions to the cotton industry of the South." Dr. Hunter also attended the meeting of the National Boll Weevil Conference held under the auspices of the American Cotton Association at Atlanta, Ga., February 20, and delivered an addresss on boll weevil control. Both Dr. Hunter and Mr. Coad were in Washington for several days following the Atlanta meeting.

The first issue of "The Canadian Insect Pest Review" appeared on April 3rd. In the "Foreword," it is stated that the object of the Review is; "to present a periodical statement on current insect conditions. It is recognized that it is difficult and sometimes unwise to foretell events relating to insect problems. Nevertheless, a certain security in this regard may be obtained if more consideration is given to the study of meteorological effects and seasonal influences. At any rate knowledge in advance may save thousands of dollars to the farmers, and publicity at the right moment will undoubtedly result in much good." The first issue contains seven multigraphed pages, two of which relate to insect conditions in the United States; this information is furnished by the compiler of the United States "Insect Pest Review Bulletin." The Review has been compiled by Mr. R. C. Treherne, Chief, Division of Field Crop and Garden Insects, from reports received from field officers and collaborators of the Branch. It should prove to be a most useful publication.

Termites are very destructive to the woodwork of buildings and their contents in the United States. Of the 40 species occurring in this country, species of *Reticulitermes* are the most injurious to buildings. In the Southern and Gulf States, however, species of *Kalotermes* and *Crytotermes* are also injurious, and in the Southwestern States species of *Kalotermes* and *Amitermes*, as well as *Reticulitermes*, are injurious. On the Pacific Coast *Reticulitermes* and *Kalotermes* damage buildings. During the

fiscal year 1922, the Forest Insect Branch of the Bureau gave advice in 118 cases in which termites had damaged the woodwork of buildings or their contents in the United States, and during the present fiscal year 74 cases of such damage have already been reported. A destructive species of West Indian termite which breeds in dry solid wood seriously damaged the woodwork and furniture in a large hotel in Miami, Fla. The termites infesting the furniture were killed by placing it in the attic directly under the roof, where the sun's rays beat down. The temperature in the attic was from 17 to 24 degrees F. higher than the maximum temperature recorded by the U. S. Weather Bureau.

During the past year the work of rearing and liberating an important parasite of the corn borer, *Habrobracon brevicornis* Wesmael, has been very successful, and this parasite has been liberated in numbers exceeding 1,000,000 individuals in the densely infested area in New England. In view of the success achieved in rearing this parasite, it was believed that it might be worth while to attempt to introduce it into the intensely infested areas of southern Ontario, and a suggestion to this effect was made to the Dominion Entomologist, Arthur Gibson, who recently has been authorized to employ an assistant for this purpose. With this end in view, A. B. Baird recently visited the Arlington, Mass., laboratory and was instructed in the technique necessary for the handling of this parasite. Mr. Baird will soon proceed to southern Ontario to conduct the preliminary work necessary for the rearing and introduction of this parasite into Canada. Several other promising parasites of the corn borer have been received from Dr. W. R. Thompson,located in France, and are being reared by Detmar W. Jones of the Arlington laboratory. Mr. Jones has shown great ingenuity in perfecting the technique for the successful rearing of these insects, and at least one additional promising species will soon be ready for liberation.

The third general meeting of the North-west International Committee on Farm Pests was held at the Agricultural College, Winnipeg, Manitoba on April 18 and 19 1923, the following entomologists being present: W. R. Walton, Washington, D. C.; Arthur Gibson and R. C. Treherne, Ottawa; Stewart Lockwood, Montana; R. L. Webster, North Dakota; H. V. Severin, South Dakota; A. G. Ruggles, Minnesota; E. H. Strickland and H. L. Seamans, Alberta; Kenneth King and M. P. Tullis, Saskatchewan; A. V. Mitchener and N. Criddle; Manitoba. Some of the sessions were also attended by members of the college staff and by J. B. Wallis, Winnipeg.

The meetings were opened with an address of welcome by Prof. C. H. Lee, acting president of the college and later Mr. J. H. Evans Deputy Minister of Agriculture also addressed the meeting.

The sessions were of an informal nature, no set papers being presented. Important subjects discussed were: The Pale Western cutworm (*P. orthogonia*), grasshoppers and grasshopper baits, the Wheat-stem Sawfly (*C. cinctus*), Hessian-fly, etc.

The committee reported upon experiments undertaken during 1922 and arranged for a uniform series of experiments to be carried on in 1923.

The importance of rainfall as a means of forcing cutworms to the surface and thus enabling parasites to attack them, was brought out, as showing the chief cause in explaining the periodic outbreaks. Cultural methods for preventing egg laying on fields and as a method of possibly destroying the eggs were discussed and a series of experiments arranged in order to obtain fuller information on these subjects.

An extensive discussion on grasshopper baits indicated the necessity of a close

study of temperature in relation to the feeding activities of grasshoppers in order to apply baits at the right time of day. It was also considered desirable to make a close study of other meteorological factors which might influence the insects' feeding habits. A number of uniform tests were arranged to be undertaken in 1923.

The alarming increase of the Wheat-stem Sawfly in Manitoba, Saskatchewan, and Alberta, and its wide distribution elsewhere, were discussed, particular emphasis being placed upon the importance of the larval habit in not cutting the stems until they begin to dry; a habit which enables farmers to harvest their crops in comparative safety by cutting them before they are dead ripe. The apparent failure of parasites to follow the sawfly into the grain crops was also discussed.

A rapid increase of Hessian-fly over certain sections of the spring wheat growing region indicated that a serious outbreak may occur in the near future and it was deemed advisable to make a close study of the insect's habits in the more northern sections of its range. The influence of humidity in relation to development was thought to be of marked importance in accounting for sudden outbreaks after the long periods of inactivity.

It was arranged to hold the next meeting at Bozeman, Montana. Mr. Criddle was reelected chairman and Prof. R. A. Cooley was chosen as secretary for that meeting.

N. C.

Horticultural Inspection Notes

In the course of ship inspection, Mr. Max Kisliuk, Jr., an inspector of the Federal Horticultural Board, located in Philadelphia, discovered a specimen of *Vriesia*, in the nurses' quarters of the United States Hospital Ship Mercy arriving from Guantanamo, Cuba, to be infested with an interesting and apparently undescribed specise of *Thrips*, apparently closely related to *Liothrips*. Incidentally, the plant was aleo infested with mealy bugs, Diaspine scale insects, ants, etc., and some of the leavss exhibited diseased spots.

Mr. Lee A. Strong, Chief of the Bureau of Plant Quarantine of California, reports that the Quarantine Inspectors of California have recently discovered that private railway cars entering that state frequently carry fruits prohibited by existing state quarantines. A recent inspection of some nine private cars resulted in the finding of fruits prohibited entry.

Mr. J. T. Rogers, an inspector of the Federal Horticultural Board stationed in Washington, has been temporarily transferred to New York to assist in the enforcement of the Plant Quarantine Act. On July 1, Mr. Rogers will be stationed at Charleston, South Carolina for the purpose of assisting the Customs Officials at that port in the enforcement of the Plant Quarantine Act.

Mr. Ivan Shiller, who during the past year has been stationed at Del. Rio, Texas, has been permanently transferred to New York City to assist in the inspection of plants and plant product imported under permit.

The Arizona State Commission of Agriculture and Horticulture has recently erected at Yuma a vacuum fumigation plant to be used in the fumigation of citrus plants arriving in that state from California. Some four carloads of such stock were fumigated at the plant in question from March 26 to 31 inclusive. The plants were

fumigated at the rate of one ounce avoirdupois of sodium cyanide per one hundred cubic feet of space with a preliminary twenty-seven inch vacuum, and an exposure of one hour.

Mr. L. R. Dorland, the inspector in charge of the work of the Federal Horticultural Board at Nogales, Arizona, recently visited the ports of Lochiel, Naco, and Douglas, Arizona, for the purpose of conferring with the Customs Officials concerning agricultural importations at those points.

Mr. C. C. Halbedl, who has been stationed at Brownsville, Texas for the past two years assisting in the examination of freight cars and passengers' baggage, recently resigned from the service of the Federal Horticultural Board for the purpose of entering commercial work.

Mr. J. W. O'Brien, a Plant Quarantine Inspector of the Federal Horticultural Board located in New York City, recently intercepted in cooperation with the Customs officials, living larvae of the European Corn Borer in stalks of broom corn contained in passenger's baggage. This material was taken from the baggage of a third-class passenger arriving from Italy who proposed to take it to Missouri. Subsequent to this interception, Mr. O'Brien discovered a similar collection in the baggage of a passenger arriving from Germany.

Professor R. W. Harned reports that the Plant Board Inspectors of Mississippi have recently intercepted a dozen or more different shipments of plants from New Orleans which were infested with the Japanese Camphor Scale, *Pseudaonidia duplex* (Ckll.). Most of these shipments were found in Parcel Post packages arriving at Jackson and Gulfport, although a few were taken in express shipments. In addition to the foregoing, Inspector H. D. Money located at Biloxi, Mississippi, discovered a truck load of Satsuma oranges from Alabama, which were heavily infested with this insect. At the time the discovery was made, many of the oranges had been delivered to stores, necessitating their confiscation and destruction.

The Federal Horticultural Board has recently completed a fumigation house at Laredo, Texas, which will accommodate twenty freight cars at one exposure. This house was placed in operation May 4, 1923 and takes the place of the one which was destroyed by fire July 19, 1922. This is probably the largest building in the world used exclusively for fumigation purposes.

In a recent communication, Professor R. W. Harned reports as follows: "The insect that is being known as *Desiantha nociva*, that was first discovered in Stone County, Mississippi in March 1922, has now been found in five counties; Stone, Harrison, Jackson, Pearl River and Hancock. Last year the insect was only noted as injuring Irish potatoes, although found on several other plants. So far this year, its greatest damage has been done to turnips. It is thought that further scouting will show that this insect occurs in several other counties in South Mississippi, and probably also in Alabama and Louisiana. It has been found close to both of these states.

"The Bureau of Entomology and the State Plant Board of Mississippi are making a desperate fight against the sweet potato weevil in Mississippi. Many conditions have been favorable to the increase of the insect, and although the eradication program has not progressed as rapidly as the authorities in charge had hoped would be the case, the insect has to a very large extent been prevented from spreading. Although a great amount of scouting is being done for this insect, it has so far been

confined to the four counties that were in the original infestation; Jackson, Hancock, Harrison, and Pearl River, except for two properties in George County and one property in Adams County. In each of these cases, the inspectors have been able to account for the infestation. George County became infested through potato sacks that were brought from Pascagoula, Mississippi. The one farm in Adams County became infested by a direct shipment of infested sweet potatoes by express. It is now believed that the weevils have been completely eradicated from the one property in Adams County, and the two properties in George County."

Mr. H. Y. Gouldman, an inspector of the Federal Horticultural Board in Washington, recently intercepted an interesting Balaninus in a small collection of chestnuts received by the Department of Agriculture from China. Mr. Gouldman has also recently collected what appears to be *Ptilinus tropicum* (Matthews) or an allied species in old wood found in a box containing orchid plants from Cristobal, Canal Zone. This is reported to be one of the smallest beetles described in Biologica Centra-Americana.

The fifth annual conference of the Western Plant Quarantine Board has been called for May 21, 22, and 23 at Phoenix, Arizona. This board is composed of the quarantine officers of the eleven western states, British Columbia, Hawaii and the northern district of Lower California. The purpose of the Board is to work toward uniform enforcement of quarantine regulations and to assist in the protection of the West from injurious insects and plant diseases not known to occur in these regions.

Mr. M. J. Kerr, Plant Quarantine Inspector of the Federal Horticultural Board stationed at New Orleans, visited Mobile during the month of May for the purpose of determining from Customs records the volume of the foreign importations of plants and plant products arriving at that port.

Mr. E. S. Jewell and Mr. V. J. Shiner motored from Laredo, Texas to San Ygnacio and Zapata, Texas for the purpose of consulting with the Customs officials and determining the amount of traffic entering the United States from Mexico and the likelihood of the entry of cotton seed and other contraband material at these ports.

Facilities for the sterilization of broom corn are now available at the port of Boston. This is a very fortunate situation, since it will make possible the shipment to Boston for prompt sterilization of broom corn which arrived in New York during the early spring infested with larvae of the European Corn Borer. Although the entry of broom corn is restricted to the months of November to March inclusive, entry of this commodity will be permitted in the future at Boston throughout the year.

Mr. W. M. Mann of the Bureau of Entomology left Washington early in January, and entered Mexico at Nogales, Ariz., to make a special investigation of the fruit fly situation in Mexico for the Federal Horticultural Board.

Mr. W. B. Wood of the Federal Horticultural Board, during the month of February, inspected the plants for distribution at the field stations of the Office of Foreign Seed and Plant Introduction at Savanah, Ga., and Brooksville and Miami, Fla.

Mr. R. D. Kennedy, inspector of the Federal Horticultural Board in Washington, D. C., recently collected what appears to be *Aspidiotus cryptoxanthus* Ckll., on walnut cuttings, and *Lepidosaphes flava* var. *hawaiiensis* (Mask.) on chestnut cuttings from Shantung, China, two scale insects not known to occur in the United States.

Apicultural Notes

Mr. A. I. Root, founder of the A. I. Root Company, Medina, Ohio, and author of the A B and C of Bee Culture died April 30 at his home in Medina at the age of 83 years.

The annual spring meeting of the Connecticut Beekeepers Association was held at the State Capitol, Hartford, on May 5. The association has about 250 members and the following officers were reelected: President H. L. Lankton; Vice-President S. J. Griffin; Secretary-Treasurer, Louis St. Clair Burr; members of executive committee, L. C. Root, J. D. Kroha, H. W. Coley: auditors, A. W. Yates, C. J. Ross.

A new bee disease law has been enacted in Ohio through the efforts of the Ohio State Beekeeper's Association, and carries an appropriation of $5,000.00 for inspection work. The enforcement of this law is in charge of Richard Paxon, Director of Agriculture, who is empowered to formulate rules and regulations concerning the inspection and shipment of bees.

Mr. A. E. Lundie, a graduate student of Cornell University, who is making a special study of beekeeping in this country, preparatory to taking up work in bee-keeping for the Union of South Africa, has spent most of the last eighteen months at the bee culture laboratory of the Bureau of Entomology near Washington. D. C. Mr. Lundie has now returned to Cornell to take his examinations for the degree of Doctor of Philosophy, and will soon return to South Africa